Digitized by the Internet Archive
in 2010 with funding from
Natural History Magazine, Inc.

http://www.archive.org/details/naturalhistory83newy

NATURAL HISTORY

VOLUME LXXXIII
1974

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
NEW YORK, N.Y.

JANUARY No. 1

AUTHORS 4
MIRACLE SEEDS AND SHATTERED DREAMS . Richard W. Franke 10
THIS VIEW OF LIFE: SIZE AND SHAPE .... Stephen Jay Gould 20
SOLVING THE MOON'S RIDDLES Vivien Gornitz and Robert Jastrow 28
A BANQUET FOR THE BIRDS Richard M. DeGraaf and Jack Ward Thomas 40
THE STARVING ROOTS OF POPULATION GROWTH Roy E. Brown and Joe D. Wray 46
TRIAL BY FIRE .... James M. Freeman 54
TENTS AND TACTICS OF CATERPILLARS . William G. Wellington 64
SKY REPORTER: A VISITOR FROM OUTER SPACE Kenneth L. Franklin 74
CELESTIAL EVENTS .... Thomas D. Nicholson 76
FISH ARE WHAT THEY EAT .... Allen Keast 78
ANNOUNCEMENTS 82
A FAINT IMAGE OF THE WILD WORLD Review by Homer Page 90
SUGGESTED ADDITIONAL READING 95

FEBRUARY No. 2

AUTHORS 2
LETTERS 4
THIS VIEW OF LIFE: SIZING UP HUMAN INTELLIGENCE Stephen Jay Gould 10
A NATURALIST AT LARGE: THE END OF THE ENERGY ORGY Kenneth E. F. Watt 16
THE NORTHERNMOST PEOPLE .... Fred Bruemmer 24
NEW ZEALAND'S MOUNTAINS: A MAJESTIC ACCIDENT Christopher H. Scholz 34
OSCAR: AN INQUIRY INTO MADNESS .... Peter J. Wilson 43
LIFE-GIVING OILS IN THE STRAIT OF GEORGIA Ritchie R. Ward 52
THE PROGRAMMED EXTINCTION OF THE SANDHILL CRANE Richard S. Miller 62
BIOS: THE BLIND STAGGERS .... Arthur W. Galston 72
CELESTIAL EVENTS .... Thomas D. Nicholson 76
"SCALY THINGS THAT SHUFFLE AND LURK . . ." Review by John H. Heminway, Jr. 78
ADDITIONAL READING 90
ANNOUNCEMENTS 92

MARCH No. 3

AUTHORS 2
LETTERS 4
THIS VIEW OF LIFE: THE RACE PROBLEM .. Stephen Jay Gould 8
BIOS: THE UNSCIENTIFIC METHOD .... Arthur W. Galston 18
FLASHING SEA PANSIES AND GLOWING MIDSHIPMEN Milton J. Cormier 26
QUAIL MUSIC .... Paul A. Johnsgard 34
A GLOBAL IMPERATIVE FOR THE ENVIRONMENT Maurice F. Strong 41
A SULTANATE ASUNEER .... George Rentz Photographs by Bruno Barbey 57
RUNNING AND JUMPING .... David P. Willoughby 68
ANNOUNCEMENTS 73
CELESTIAL EVENTS .... Thomas D. Nicholson 74
SKY REPORTER: A FUNNY THING HAPPENED TO COMET KOHOUTEK .... Stephen P. Maran 76
IS SCIENCE REALLY NECESSARY? .. Review by Edward Edelson 84
ADDITIONAL READING 96

APRIL No. 4

AUTHORS 2
LETTERS 4
BIOS: THE SPECTER BEHIND THE STATISTICS Arthur W. Galston 6
A TALE OF TWO TRAVELERS .... Robert Herendeen 16
THIS VIEW OF LIFE: THE NONSCIENCE OF HUMAN NATURE Stephen Jay Gould 21
A NEW PROFILE FOR THE WOLF .... L. David Mech 26
EVOLUTION UNDER ATTACK .... Norman D. Newell 32
COMFORTABLE OLD SHRINES; DIVISIVE NEW VISIONS Jerome L. Mintz 40
THE DEFLOWERING OF CENTRAL AMERICA .... Daniel H. Janzen 48
CELESTIAL CLUES TO EGYPTIAN RIDDLES ... Gerald S. Hawkins 54
A MATTER OF TASTE: SOME LIKE IT HOT .. Raymond Sokolov 64
SKY REPORTER: ATMOSPHERIC TITAN .... Gregory Benford 69
CELESTIAL EVENTS .... Thomas D. Nicholson 74
WHERE AND HOW WE'LL GROW .... Review by Gladwin Hill 76
ADDITIONAL READING 87
ANNOUNCEMENTS 88

May No. 5

Authors 2
Letters 6
The Human Strategy: Potlatch Politics and Kings' Castles Marvin Harris 10
Bios: Which End Is Up? .... Arthur W. Galston 20
This View of Life: Racist Arguments and I.Q. Stephen Jay Gould 24
Birth of a Harbor Seal .... Peter M. Knudtson 30
Season of the Apple .... Patricia W. Spencer 38
Precarious Odyssey of an Unconquered Parasite Kenneth S. Warren 46
Toward Infallible Earthquake Prediction Christopher H. Scholz 54
Life in the Camel's Shadow .... William Torry 60
A Matter of Taste: A Morel Tale .... Raymond Sokolov 70
Sky Reporter: The Quasar Controversy .... Robert Jastrow 74
Celestial Events .... Thomas D. Nicholson 78
"What Did You Say?" .... Review by Brian Sutton-Smith 80
Additional Reading 94
Announcements 96

June-July No. 6

Authors 2
Letters 4
Bios: The Ungreening of South Vietnam Arthur W. Galston 10
This View of Life: Darwin's Dilemma ... Stephen Jay Gould 16
Caves of the Infinite Buddhas .... Judith M. Treistman 24
When the Turtle Collapses, the World Ends Bernard Nietschmann 34
Guns of the Tau Sug .... Thomas M. Kiefer 44
Celestial Events .... Thomas D. Nicholson 52
The New Town Bird Quadrille .... Aelred D. Geis 54
Sky Reporter: Are We Alone in the Cosmos? Robert Jastrow 62
The Rise and Fall of Heroin Addiction Robert L. DuPont 66
Home Is Where the Hearth Is..Review by Edward Abbey 72
Announcements 76
A Matter of Taste: The Turn of the Ewe Raymond Sokolov 78
Additional Reading 83

August-September No. 7

Authors 2
Letters 8
Disappearance of the Historic Ship *Tijger* Christopher L. Hallowell 12
This View of Life: On Heroes and Fools in Science Stephen Jay Gould 30
Images of a Vibrant World 34
Desert Farmers: Ancient and Modern ...... Michael Evenari 42
The Spiral Way .... Gerald Oster 50
Sun, Sand, and Sea Lions .... G. Causey Whittow 56
A Matter of Taste: The Ritual of Maize Raymond Sokolov 64
Driftwood Fantasy .... Robert Sommer 72
Sky Reporter: How Old Is the Universe? . Robert Jastrow 80
Celestial Events .... Thomas D. Nicholson 84
Bios: The Membrane Barrier .... Arthur W. Galston 86
Birding by the Book .... Review by Robert Arbib 92
Additional Reading 100
Announcements 102

October No. 8

Authors 1
Letters 8
Short-circuiting the Cheap Power Fantasy George M. Woodwell 16
This View of Life: The Great Dying .... Stephen Jay Gould 22
A Naturalist at Large: The Flowing Well of Life Raymond B. Cowles 31
Beautiful Gamblers of the Biosphere .. Edward S. Ayensu 36
Song of the Bunting William L. Thompson and Kenneth A. Shiovitz 46
The Sharecropper's Plague .... Daphne A. Roe 52
Central Park's Fragile Dinosaurs .... Adrian J. Desmond 64
Special Hunt of the Sharanahua .... Janet Siskind 72
Keeping Afloat in a Changing World Review by Luther P. Gerlach 80
Sky Reporter: Far-out Comet Watching Stephen P. Maran 90
A Matter of Taste: One Man's Meat is Another's Person Raymond Sokolov 100
Additional Reading 106
Celestial Events .... Thomas D. Nicholson 108
Announcements 111

November No. 9

Authors 5
The Changing Prey of Maine's Early Hunters Dean Snow 14
Letters 26
This View of Life: An Unsung Single-celled Hero Stephen Jay Gould 33
The Graceful and Rapacious Weasel ..... E. Raymond Hall 41
Stripping the Appalachians .... Branley Allan Branson 52
Island of Saints, Scholars, and Scléip. John C. Messenger 62
Ecology of the Intestinal Tract .... Gerald T. Keusch 70
Desert Adaptation .... Photographs by Anthony Bannister 80
A Matter of Taste: Realm of the Rice Eater Raymond Sokolov 82
Sky Reporter: Détente in Space .... Michael B. McElroy 86
Bios: Molding New Plants .... Arthur W. Galston 94
The Great Irish Telescope .... Trevor C. Weekes 98
Epitaph for a Fossil Hunter ...... Review by Ronald Singer 103
Celestial Events .... Thomas D. Nicholson 112
Announcements 115
Additional Reading 118

December No. 10

Authors 2
Captive Breeding: Boon or Boondoggle David R. Zimmerman 6
The Shell Game .... Syd Radinovsky and Alex Henderson 22
Celestial Events .... Thomas D. Nicholson 30
'Twas the Eve of Saint Nicholas .... Rudi Haas 32
The Taung Skull Revisited .... Phillip V. Tobias 38
A Hominid Skull's Revealing Holes .... C. K. Brain 44
A Special Light to Steer By .... William G. Wellington 46
A Vision of Primal Man .... Review by Peter Beard 54
A Matter of Taste: The Taste Makers . Raymond Sokolov 64
This View of Life: Darwin's Delay .... Stephen Jay Gould 68
Additional Reading 71
Sky Reporter: Molecules between the Stars Richard McCray 72
Announcements 80

INDEX TO VOLUME LXXXIII

AUTHORS AND TITLES

A

- Abbey, E., Review, June, p.72
- Arbib, R., Review, Aug., p.92
- Ayensu, E.S., Beautiful Gamblers of the Biosphere, Oct., p.36

B

- Bannister, A., Desert Adaptation, Nov., p.80
- Beard, P., Review, Dec., p.54
- Benford, G., Sky Reporter: Atmospheric Titan, Apr., p.69
- Brain, C.K., A Hominid Skull's Revealing Holes, Dec., p.44
- Branson, B.A., Stripping the Appalachians, Nov., p.52
- Brown, R.E., The Starving Roots of Population Growth, Jan., p.46
- Bruemmer, F., The Northernmost People, Feb., p.24

C

- Chamberlain, B.B., Review, May, p.90
- Cormier, M.J., Flashing Sea Pansies and Glowing Midshipmen, Mar., p.26
- Cowles, R.B., The Flowing Well of Life, Oct., p.31

D

- DeGraaf, R.M., A Banquet for the Birds, Jan., p.10
- Desmond, A.J., Central Park's Fragile Dinosaurs, Oct., p.64
- DuPont, R.L., The Rise and Fall of Heroin Addiction, June, p.66

E

- Edelson, E., Review, Mar., p.84
- Ehrlich, P.R., Review, Nov., p.107
- Estes, R.D., Review, May, p.84
- Evenari, M., Desert Farmers: Ancient and Modern, Aug., p.12

F

- Franke, R.W., Miracle Seeds and Shattered Dreams, Jan., p.10
- Franklin, K.L., Sky Reporter: A Visitor from Outer Space, Jan., p.74
- Freeman, J.M., Trial by Fire, Jan., p.54

G

- Galston, A.W., The Blind Staggers, Feb., p.72; The Unscientific Method, Mar., p.18; The Specter Behind the Statistics, Apr., p.6; Which End Is Up? May, p.20; The Ungreening of South Vietnam, June, p.10; The Membrane Barrier, Aug., p.86; Molding New Plants, Nov., p.94
- Gay, J., Review, Apr., p.78
- Geis, A.D., The New Town Bird Quadrille, June, p.54
- Gerlach, L.P., Review, Oct., p.80
- Gornitz, V., Solving the Moon's Riddles, Jan., p.28
- Gould, S.J., Size and Shape, Jan., p.20; Sizing Up Human Intelligence, Feb., p.10; The Race Problem, Mar., p.8; The Nonscience of Human Nature, Apr., p.21; Racist Arguments and I.Q., May, p.24; Darwin's Dilemma, June, p.16; On Heroes and Fools in Science, Aug., p.30; The Great Dying, Oct., p.22; An Unsung Single-celled Hero, Nov., p.33; Darwin's Delay, Dec., p.68
- Growald, P.J., Review, Nov., p.107

H

- Haas, R., 'Twas the Eve of Saint Nicholas, Dec., p.32
- Hall, E.R., The Graceful and Rapacious Weasel, Nov., p.44
- Hallowell, C.L., Disappearance of the Historic Ship *Tijger*, Aug., p.12
- Harris, M., Potlatch Politics and King's Castles, May, p.10
- Hawkins, G.S., Celestial Clues to Egyptian Riddles, Apr., p.54
- Heminway, J.H., Jr., Review, Feb., p.78
- Henderson, A., The Shell Game, Dec., p.22
- Herendeen, R., A Tale of Two Travelers, Apr., p.16
- Hill, G., Review, Apr., p.76
- Hunter, C.B., Film Review, Apr., p.82

J

- Janzen, D.H., The Deflowering of Central America, Apr., p. 48
- Jastrow, R., Solving the Moon's Riddles, Jan., p.28; Sky Reporter: The Quasar Controversy, May, p.74; Are We Alone in the Cosmos? June, p.62; How Old Is the Universe? Aug., p.80
- Johnsgard, P.A., Quail Music, Mar., p.34

K

- Keast, A., Fish Are What They Eat, Jan., p.78
- Keusch, G.T., Ecology of the Intestinal Tract, Nov., p.70
- Kiefer, T.M., Guns of the Tau Sug, June, p.44
- Knudtson, P.M., Birth of a Harbor Seal, May, p.30

L

- La Barre, W., Review, Oct., p.85

M

- Maran, S.P., Sky Reporter: A Funny Thing Happened to Comet Kohoutek, Mar., p.76; Far-out Comet Watching, Oct., p.90
- Martin, P.S., Review, Mar., p.90
- McCray, R., Sky Reporter: Molecules between the Stars, Dec., p.72
- McElroy, M.B., Sky Reporter: Détente in Space, Nov., p.86
- Mech, L.D., A New Profile for the Wolf, Apr., p.26
- Messenger, J.C., Island of Saints, Scholars, and Scléip, Nov., p.62
- Miller, R.S., The Programmed Extinction of the Sandhill Crane, Feb., p.62
- Mintz, J.L., Comfortable Old Shrines; Divisive New Visions, Apr., p.40

N

- Newell, N.D., Evolution under Attack, Apr., p.32
- Nicholson, T.D., Celestial Events, Jan., p.76; Feb., p.76; Mar., p.74; Apr., p.74; May, p.78; June, p.52; Aug., p.84; Oct., p.108; Nov., p.112; Dec., p.30
- Nietschmann, B., When the Turtle Collapses, the World Ends, June, p.34

O

- Oster, G., The Spiral Way, Aug., p.50

P

- Page, H., Review, Jan., p.90

R

- Radinovsky, S., The Shell Game, Dec., p.22
- Rentz, G., A Sultanate Asunder, Mar., p.57
- Roe, D.A., The Sharecropper's Plague, Oct., p.52

S

- Schlee, S., Review, Nov., p.107
- Scholz, C.H., New Zealand's Mountains: A Majestic Accident, Feb., p.34; Toward Infallible Earthquake Prediction, May, p.54
- Shapiro, H.L., Review, Oct., p.82
- Shiovitz, K.A., Song of the Bunting, Oct., p.16
- Singer, R., Review, Feb., p.86; Nov., p.103
- Siskind, J., Special Hunt of the Sharanahua, Oct., p.72
- Snow, D., The Changing Prey of Maine's Early Hunters, Nov., p.14
- Sokolov, B., Some Like It Hot, Apr., p.64; A Morel Tale, May, p.70; The Turn of the Ewe, June, p.78; The Ritual of Maize, Aug., p.64; One Man's Meat is Another's Person, Oct., p.100; Realm of the Rice Eater, Nov., p.82; The Taste Makers, Dec., p.64
- Sommer, R., Driftwood Fantasy, Aug., p.72
- Spencer, P.W., Season of the Apple, May, p.38
- Strong, M.F., A Global Imperative for the Environment, Mar., p.41
- Sutton-Smith, B., Review, May, p.80

T

- Thomas, J.W., A Banquet for the Birds, Jan., p.40
- Thomas, P.D., Review, May, p.87
- Thompson, W.L., Song of the Bunting, Oct., p.46
- Tobias, P.V., The Taung Skull Revisited, Dec., p.38
- Torry, W., Life in the Camel's Shadow, May, p.60
- Treistman, J.M., Caves of the Infinite Buddhas, June, p.24

V

- Van den Bosch, R., Review, Apr., p.80

W

- Ward, R.R., Life-giving Oils in the Strait of Georgia, Feb., p.52
- Warren, K.S., Precarious Odyssey of an Unconquered Parasite, May, p.16
- Watt, K.E.F., The End of the Energy Orgy, Feb., p.16
- Weekes, T.C., The Great Irish Telescope, Nov., p.98
- Wellington, W.G., Tents and Tactics of Caterpillars, Jan., p.64; A Special Light to Steer By, Dec., p.46
- Whittow, G.C., Sun, Sand, and Sea Lions, Aug., p.56
- Willoughby, D.P., Running and Jumping, Mar., p.68
- Wilson, P.J., Oscar: An Inquiry into Madness, Feb., p.43
- Woodwell, G.M., Short-circuiting the Cheap Power Fantasy, Oct., p.16
- Wray, J.D., The Starving Roots of Population Growth, Jan., p.16

Z

- Zimmerman, D.R., Captive Breeding: Boon or Boondoggle, Dec., p.6

SUBJECT MATTER

- Africa
  - Camel herding tribes, May, p.60
  - Hominid species, Dec., p.38; p.44
  - Namib Desert, Nov., p.80
  - Nuba tribes, Dec., p.54
- American Indians
  - Cemeteries in Maine, Nov., p.14
  - Kwakiutl, May, p.10
  - Miskito, Mexico, June, p.34
  - and Potlatch, May, p.10
  - Sharanahua tribe, Oct., p.72
- American-Russian space travel, Nov., p.86
- Animal Behavior
  - Birds, June, p.54
  - Bunting, indigo, Oct., p.46
  - Caterpillars, tent, Jan., p.64
  - Fishes, Jan., p.78
  - Hermit crabs, Dec., p.22
  - Insects, Dec., p.46
  - Quails, Mar., p.34
  - Sandhill crane, Feb., p.62
  - Sea lions, Aug., p.56
  - Seals, May, p.30
  - Snakes, Nov., p.80
  - Weasel, Nov., p.44
  - Whooping crane, Dec., p.6
  - Wolves, Apr., p.26
- Anthropology
  - American Indians, Maine, Nov., p.14
  - Camel-herding tribes, May, p.60
  - Caribbean man, Oscar, Feb., p.43
  - China, ancient monuments, June, p.24
  - Egypt, sphinx, Apr., p.54
  - Eskimo, Feb., p.24
  - Indian fire walkers, Jan., p.54
  - Inis Beag (Ireland), people of, Nov., p.62
  - Kwakiutl and potlatch, May, p.10
  - Meskito Indians, June, p.34
  - Nuba tribes, Dec., p.54
  - Omani, Mar., p.57
  - Sharanahua tribe, Oct., p.72
  - Ship *Tijger*, Aug., p.12
  - Spanish shrines, Apr., p.40
  - Tau Sug, June, p.44
- Apollo missions and moon, Jan., p.28
- Appalachia, coal deposits, Nov., p.52
- Apple trees, blossoms of, May, p.38
- Archeology *see* Anthropology
- Art
  - Driftwood, Aug., p.73
  - Yün-kang shrines, June, p.24
- Astrochemistry, Dec., p.72
- Astronauts and Comet Kohoutek, Oct., p.90
- Astronomy
  - Celestial events, Jan., p.76; Feb., p.76; Mar., p.74; Apr., p.74; May, p.78; June, p.52; Aug., p.84; Oct., p.108; Nov., p.112; Dec., p.30
  - Comet Kohoutek, Jan., p.74, 76; Mar., p.76; Oct., p.90
  - Cosmos, June, p.62
  - Galactic measurements, Aug., p.80
  - Molecules and stars, Dec., p.72
  - Moon, Jan., p.28
  - Orbital mission, Nov., p.86

  Quasar, May, p.74
  Sky Reporter, Jan., p.74; Mar., p.76; Apr., p.69; May, p.74; June, p.62; Aug., p.80; Oct., p.90; Nov., p.86; Dec., p.72
  Sphinx, celestial clues, Apr.. p.54
  Stars, molecules between, Dec., p.72
  Telescope, Irish, Nov., p.98
  Titan, Saturn's satellite, Apr., p.69
Australopithecine, Dec., p.38; p.44
Austria and Christmas, Dec., p.32
BIOLOGY
  Brain, Feb., p.10
  Cells, Aug., p.86
  Determinism, Apr., p.21
  Intestinal tract, Nov., p.70
  Plants, alteration of, Nov., p.94
  Rangeland plants, Feb., p.72
Bioluminescence, Mar., p.26
BIOS
  Blind staggers, Feb., p.72
  Cells, Aug., p.86
  Plants, alteration of, Nov., p. 94; direction of growth, May, p.20
  Population growth and food, Apr., p.6
  Ungreening of South Vietnam, June, p.10
  Unscientific method, Mar., p.18
BIRDS
  Indigo bunting, Oct., p.46
  Quails, Mar., p.34
  Sandhill crane, Feb., p.62
  Urban, June, p.54
  Whooping crane, Dec., p.6
  Wild, Jan., p.40
Birth control and population growth, Jan., p.46
BOTANY
  Apple tree, May, p.38
  Maize, Aug., p.56
  Mushroom, May, p.70
  Orchids, Oct., p.36
  Plants, Feb., p.72; Mar., p.18; Nov., p.94
  Rice, Jan., p.10; Nov., p.82
  Seeds, Jan., p.10; May, p.20; Oct., p.36; Nov., p.82
Buddhism, China, June, p.24
Bunting, song of, Oct., p.46
Burial sites, prehistoric, Nov., p.14
Cambrian period, Nov., p.33
Camels, May, p.60
Caterpillars, tent, Jan., p.64
Celestial events *see* Astronomy
Cells, Aug., p.86
Central America, tropical ecosystem, Apr., p.48
Chemical warfare, South Vietnam, June, p.10
China, northern, June, p.24
Chinese history, caves of Buddhas, June, p.24
Christmas, Dec., p.32
Coal deposits, Nov., p.52
Comet Kohoutek, Jan., p.74, 76; Mar., p.76; Oct., p.90
Computer and sphinx, Apr., p.54
Continents, colliding of, Oct., p.22
Copepods, Feb., p.52
Corn (maize), Aug., p.56
Cosmos, June, p.62
Cranes, sandhill, Feb., p.62; whooping, Dec., p.6
Darwin's theory, Apr., p.32; June, p.16; Dec.. p.68
DESERT
  Namib. Africa, Nov., p.80
  Negev, Israel, Aug., p.42
  Travel and camels, May, p.60
Design in nature, Jan., p.20
Détente in space, Nov., p.86
Diatoms, Feb., p.52
Digestive system, Nov., p.70
Dinosaurs, Oct., p.64
DISEASE
  Alkali and sheep, Feb., p.72
  Parasitic, May, p.46
  Pellagra, Oct., p.52
Driftwood, Aug., p.73
Earthquake prediction, May, p.54
Ecological theory, Oct., p.22; Nov., p.33
ECOLOGY
  and Energy, Oct., p.16
  Wild birds, Jan., p.40
ECOSYSTEM
  Marine food chain, Feb., p.52
  Tropical, Apr., p.48
Egypt, sphinx, Apr., p.54
ENERGY
  Crisis, Feb., p.16
  Technology, Oct., p.16
  and Vacations, Apr., p.16
Environment, global, Mar., p.41; South Vietnam, June, p.10
Eskimo, Greenland, Feb., p.24
EVOLUTION
  Darwin, June, p.16; Dec., p.68
  Population, Oct., p.31
  Theology and science, Apr., p.32
  Theory, June, p.16; Nov., p.33
Fire walkers, India, Jan., p.54
FISHES
  Bioluminescence, Mar., p.26
  Mouths of, Jan., p.78
Flatworms, parasites, May, p.46
FOOD
  Barbecue, June, p.78
  Corn, Aug., p.56
  and Fishes, Jan., p.78
  Hot peppers, Apr., p.64
  Cannibalism, Oct., p.100
  Mushroom, morel, May, p.70
  and Pellagra, Oct., p.52
  and Population growth, Apr., p.6
  Rice, Nov., p.82
  and Taste buds, Dec., p.64
Food chains, marine, Feb., p.52
Fruit, apples, May, p.38
Fungi, bioluminescence, Mar., p.26
Gabra, camel-herding tribe, May, p.60
Galactic measurements, Aug., p.80
Genetics and race, May, p.24
GEOLOGY
  Earthquakes, May. p.54
  Mountains, Feb., p. 34
Greenland, Eskimo, Feb., p.24
Guns and the Tau Sug. June, p.44
Herbivores, Feb., p.72
Hermit crabs, Dec., p.22
Heroin addiction, June, p.66
Hominids, Dec., p.38; p.44
Hornlark, prairie, June, p.54
Human nature, nonscience of, Apr., p.21
HUMAN STRATEGY
  Potlatch, May, p.10
India, fire walkers, Jan., p.54
Indians *see* American Indians
Indigo bunting *see* Bunting
INSECTS
  Bioluminescence, Mar., p.26
  Caterpillars, Jan., p.64
  and Light waves, Dec., p.46
Intelligence, sizing up human, Feb., p.10; Oscar, inquiry, Feb., p.43
Intestinal tract, Nov., p.70
INVERTEBRATES
  Bioluminescence, Mar., p.26
  Copepods, Feb., p.52
  Flatworms, May, p.46
  Hermit crabs, Dec., p.22
Ireland, people of Inis Beag, Nov., p.62; telescope, Nov., p.98
Islamic religion, Nov., p.57
Israel, Negev Desert, Aug., p.42
Java, Indonesia, rice, Jan., p.10
Jumping and running, Mar., p.68
Kohoutek, comet, Jan., p.74, 76; Mar., p.76; Oct., p.90
Kwakiutl Indians, Vancouver Island, May, p.10
LETTERS TO THE EDITOR, Feb., p.4; Mar., p.4; Apr., p.4; May, p.6; June, p.4; Aug., p.8; Oct., p.8; Nov., p.26
Maine and American Indians, Nov., p.14
Maize, Aug., p.56
MAMMALS
  Camels, May, p.60
  Sea lions, Aug., p.56
  Seals, May, p.30
  Weasel, Nov., p.44
  Wolf, Apr., p.26
Marine life, collision of continents, Oct., p.22
MATTER OF TASTE
  Barbecue, June, p.78
  Cannibalism, Oct., p.100
  Maize, Aug., p.56
  Morels, May, p.70
  Peppers, hot, Apr., p.64
  Rice, Jan., p.10; Nov., p.82
  Taste buds, Dec., p.64
Membranes and cells, Aug., p.86
Mexico, Miskito Indians, June, p.34
Miracle seeds, rice, Jan., p.10
Miskito Indian turtlemen, June, p.34
Molecules and stars, Dec., p.72
Monuments, ancient China, June, p.24; Egypt, sphinx, Apr., p.54
Moon, Jan., p.28
Morel, mushroom, May, p.70
Mountains, New Zealand, Feb., p.34
Muslim religion, June, p.44
Namib Desert, Africa, Nov., p.80
NASA, Nov., p.86
NATURALIST AT LARGE
  Energy, Feb., p.16
  Evolution, Oct., p.31
  Whooping crane, Dec., p.6
Negev Desert, Israel, Aug., p.42
New York and ship *Tijger*, Aug., p.12
New Zealand, mountains of, Feb., p.34
Nuba tribes, Dec., p.54
Oman, Arab monarchy, Mar., p.57
Orchids, Oct., p.36
Paleoanthropology, Dec., p.38, p.44
Parasites, flatworms, May, p.46
Pellagra, Oct., p.52
Peru, Sharanahua tribe, Oct., p.72
Philippine Islands, Tau Sug and guns, June, p.44
Photography, competition, Aug., p.30; Want list, Nov., p.28
Plants *see* Botany
Politics and dinosaurs, Oct., p.64

POPULATION
  Evolution, Oct., p.31
  Growth, Jan., p.46
  Growth and food, Apr., p.6
Potlatch, May, p.10
Prehistoric burial sites, Maine, Nov.. p.14
Quails, Mar., p.34
Quasar, May, p.74
Race and genetics, May, p.24; species and subspecies, Mar., p.8
Recipes, Apr., p.64; May, p.70; June, p.78; Aug., p.64; Oct., p.100; Nov., p.82; Dec., p.64

RELIGION
  Buddhism, China, June, p.24
  and Evolution, Apr., p.32
  Islamic, Mar., p.57
  Muslim, June, p.44
  Spanish shrines, Apr., p.40
Rendille, camel-herding tribe, May, p.60
Reptiles, snakes, Nov., p.80; turtle, June, p.34
Rice, Jan., p.10; Nov., p.82
Running and jumping, Mar., p.68
Sandhill cranes, Feb., p.62
Saturn's satellite, Apr., p.69
Schistosomiasis, May, p.46

SCIENCE
  Heroes and fools, Aug., p.30
  Movies, fiction, Jan., p.20
  and Nonscience, Apr., p.21
  and Theology, Apr., p.32
Scientists, Aug., p.30
Sea lion, Aug., p.56
Seals, harbor, May, p.30
Sea pansies, Mar., p.26

SEEDS
  Growing of, May, p.20
  Orchids, Oct., p.36
  Rice, Jan., p.10; Nov., p.82
Seismology, May, p.54
Selenium, Feb., p.72
Skull, hominid, Dec., p.38, p.44
Sky Reporter *see* Astronomy
Snakes, Namib Desert, Nov., p.80
Solar energy, Oct., p.16
South Vietnam, June, p.10
Space, joint mission, Nov., p.86
Spain, Brotherhood of the Virgin, Apr., p.40
Sphinx, Egypt, Apr., p.54
Spirals, Aug., p.50
Stars, molecules between, Dec., p.72
Statistics and population growth, Apr., p.6
Strip mining, Appalachia, Nov., p.52
Taste buds. Dec., p.64
Tau Sug, Philippines, June, p.44
Technology, Oct., p.16
Telescope, Irish, Nov., p.98
Theology and science, Apr., p.32
THIS VIEW OF LIFE
  Biological determinism, Apr., p.21
  Brain, Feb., p.10
  Continents, collision of, Oct., p.22
  Darwin, Dec., p.68
  Ecology, Nov., p.33
  Evolution, June, p.16
  Laws of design, Jan., p.20
  Race and I.Q., May, p.24
  Race problem, Mar., p.8
  Science, Aug., p.30
Tijger. disappearance of, Aug., p.12
Titan, Saturn's satellite, Apr., p.69
Tropical ecosystem, Apr., p.48
Turtles, June, p.34
Urbanization, bird population, June, p.54
Vacations and energy, Apr., p.16
Water and the cosmos, June, p.62
Weasel, color change, Nov., p.44
Whooping crane, breeding, Dec., p.6
Wolf, Apr., p.26
World's age and galactic measurements, Aug., p.80
Worms *see* flatworms

BOOKS IN REVIEW

Africa Counts. Apr., p.78
Ark II. Oct., p.80
Bare Bones, Feb., p.86
Bird Books, a Recommended List, Aug., p.92
Bone Hunters, The, Mar., p.90
By the Evidence, Nov., p.103
DDT Myth, The, Apr., p.80
Eyelids of Morning: The Mingled Destinies of Crocodiles and Man, Feb., p.78
Greatest Adventure, The, Mar., p.84
Humboldt and the Cosmos, May, p.87
In the Human Interest, Nov., p.107
Last of the Nuba, The, Dec., p.55
Pacific Islanders, The, Oct., p.83
Peyote Hunt, Oct., p.85
Shelter, June, p.72
This Living Reef, Nov., p.107
Use of Land, The, Apr., p.76
Vanishing Herds, May, p.84
Wild Places: A Photographic Celebration of Unspoiled America, The, Jan., p.90
Word Play, May, p.80
World's Finest Minerals and Crystals, May, p.90

FILM REVIEW

Mystery of the Maya, Apr., p.82

NATURAL HISTORY

[illegible]

satour
kruger national park

IN THE RSA WE KEEP THIS ONE IN A CAGE THE SIZE OF MASSACHUSETTS.

Conservation is a big word in the RSA. The cheetah fastest of all the predators, roams at will in Kruger National Park – one of many huge game reserves in the Republic. Throughout the country... 850 species of birds, 800 species of butterflies... 1500 species of fish...18000 different kinds of plants...the greatest variety of African animals and sophisticated cities with international hotels.

Write now for our free 52-page full colour magazine "Discover the RSA." It will show you that a visit to South Africa is an experience no serious conservationist can afford to miss.

South African Tourist Corporation,
Rockefeller Center, 610 Fifth Ave.,
New York, N.Y. 10020, or Suite 721,
9465 Wilshire Boulevard,
Beverley Hills, California 90212.

DISCOVER THE REPUBLIC OF SOUTH AFRICA

Mail attached card
to receive your
Color Slide Album of 24

IMPRESSIONIST
PAINTINGS

for only $1

[Comparable value: $15 to $18]

with a trial
subscription
to the McGraw-Hill
Color Slide Program
of Art Enjoyment

NIST
IMPRESSIONIST
PAINTING
THE
COLOR SLIDE
BOOK OF THE
WORLD'S ART

FIRST CLASS
PERMIT NO. 26
NEW YORK, N. Y.

BUSINESS REPLY MAIL
No Postage Stamp Required if Mailed in the U.S.

Postage will be paid by

McGraw-Hill
Color Slide Program
of Art Enjoyment
1221 Avenue of the Americas
New York, N.Y. 10020

McGraw-Hill Color Slide Program of Art Enjoyment, Dept. AY-127
1221 Ave. of the Americas, New York, N.Y. 10020

PLEASE enter my trial subscription and send me the complete *Color Slide Album of Impressionist Painting* (including 24 color slides and 48-page illustrated art book). Bill me only $1, plus a few cents for shipping. If I am not delighted with this introductory package, I may return everything within 10 days, cancel my subscription, and owe nothing.

If I do continue, you will send me a new Color Slide Album approximately every six weeks (for 10 days trial examination) and bill me at the subscriber's low price of $7.95, plus shipping. I may take as few or as many Albums as I like, and may stop whenever I wish. After my fourth shipment I will be given a choice of receiving all remaining albums in two convenient shipments, or continuing with single-album shipments.

Name..................................

Address...............................

City..................................

State.....................Zip No.........

☐ Check here if you wish the Kodak Carousel 600 Projector included and remit $48.95, plus tax, with this card in envelope addressed to McGraw-Hill Color Slide Program of Art Enjoyment. If not delighted, return the projector within 10 days for full refund.

This offer applies to U.S. and Canada only. AY-127

Imagine the thrill of viewing Renoir's famous "Le Moulin de la Galette" — in all the shimmering color and full size of the original painting — right in your own living room! This beautiful work is just one of 24 world-renowned Impressionist masterpieces you and your family will enjoy when you receive your introductory Color Slide Album.

MAIL ATTACHED CARD TODAY

SEND NO MONEY — NO POSTAGE REQUIRED

If — until today — your experience with art masterpieces has been limited, for the most part, to scaled-down "prints" and reproductions in books . . .

Imagine the excitement of viewing the world's great paintings in the FULL SIZE and GLOWING COLORS of the original canvases— on your own wall at home!

A REMARKABLE DEMONSTRATION OFFER FROM

THE McGRAW HILL Color Slide Program of Art Enjoyment

TAKE THIS ALBUM OF IMPRESSIONIST PAINTINGS FOR ONLY $1 [comparable value: $15 to $18]

HAVE you ever wondered why people who are otherwise well-informed often fail to develop a real understanding and enthusiasm for so many of the world's great paintings? Perhaps it is because most of us only rarely have the experience of standing before the original works of art.

Imagine then, what it would be like to view these celebrated masterpieces *in your own home* — just as they appear in leading museums and the collections of the world's great art patrons! This extraordinary experience is now open to you through a series of remarkable Albums offered to members of the McGraw-Hill Color Slide Program of Art Enjoyment. There has never been anything like it.

A new way to enjoy the world's great art

As a member of this Program, you will gaze in astonishment as Renoir's lovely "Seated Bather" (shown above) appears on your wall *four feet high* — aglow with all the vibrant reds, blues and greens of the Impressionist palette; you will thrill to Rembrandt's famed "Aristotle Contemplating the Bust of Homer," seen *nearly five feet in height* — and marvel as you view Titian's allegorical masterpiece "Sacred and Profane Love" in its *full eight-foot width*, just as it appears in Rome's Borghese Gallery.

These are just a few of the scores of magnificent works of art you will see projected in the actual size and full color of the original paintings.

Accept this $1 demonstration offer

If you mail the attached card, you will receive a unique Album containing 24 color slides of priceless works by Renoir, Monet, Degas and other important Impressionist painters. These slides are produced in Florence to exacting specifications on 35mm Kodak film in individual 2 x 2 mounts. They set a new standard of faithfulness to the artists' originals, and can be used in any home slide projector. (If you do not own a projector, you may obtain one at very low cost with your trial Album. See special offer below.)

The color slides, however, are only one part of this elaborate Album. Bound into the center is an illustrated 48-page book by Albert Châtelet, Director of France's renowned Lille Museum — with a guide to each of the slide pictures and the complete story of the Impressionist era.

If this demonstration pleases you, you will be offered a new slide-and-commentary Album as issued, at two-month intervals. Among the Albums in this series are *Italian Renaissance Painting*, with masterpieces by Leonardo da Vinci, Michelangelo, Raphael, and others — *The Golden Age of Spanish Painting*, with works by El Greco, Velasquez, and their contemporaries — and Albums covering every major art period.

Until today, slide-and-commentary art education was available only in museums or universities. Now, you can benefit from the same kind of expert guidance — and enjoy the world's great masterpieces with your family and invited guests — right in your own home.

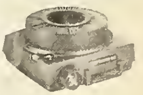
The cost is surprisingly low

The least you might expect to pay for 24 color slides of comparable quality—if the subjects were available from museums and private collections—is $15 to $18. Yet, as a subscriber to this new Program, you pay only $7.95, plus a few cents for shipping, *for each complete Album*—including slides and illustrated guide book. You may take as few or as many as you like, and may stop whenever you wish.

Mail attached card for 10 days trial

Send no money now. We will ship your introductory Color Slide Album of Impressionist Painting and enroll you as a trial subscriber. If you are thrilled with the demonstration, send only $1, plus a few cents for shipping. Thereafter, you will be offered a new Album approximately every six weeks at the subscribers' low price of only $7.95. You will also be given the opportunity to elect to receive remaining volumes. If not delighted, however, you may return everything within 10 days, and owe nothing. Mail the attached card today.

IF YOU DO NOT HAVE A PROJECTOR, here's an unusual opportunity. We can offer you the sensational Kodak Carousel 600 Projector supplied with a 500-watt lamp, and 3-inch f/3.5 Ektanar lens. This top-rated projector shows all regular 2"x2" 35mm slides. It has dependable gravity feed and you have instant access to any slide at any time. List price $64.95 — subscribers' price only $48.95, plus tax. Remittance must accompany trial subscription form. If you are not completely delighted with the projector, you may return in 10 days for a full refund.



If Reply Card has been removed, write Color Slide Program of Art Enjoyment, Dept. AY-127, 1221 Ave. of the Americas, N.Y., N.Y. 10020.

TYROPHILES OF THE WORLD—UNITE!*

CHEESE LOVERS

INTERNATIONAL

invites you to order your favorite cheeses "DIRECT" through our Club (now over 30,000 members)—and enjoy many imported "specials" at just 3¢ to 7¢ above wholesale!

LOOK AT THESE CHEESES!

- **Prize French CAMEMBERT, smooth and creamy gold.** A perfect "love-match" for fresh fruit and rich red wine. *Club price this month only 4c above wholesale — so hurry!*
- **Famous original French PORT SALUT** — luscious with Beaujolais and crisp red apple. *Recent Club "Special just 7c above wholesale!*
- **Mellow Norwegian JARLSBERG from the crystal fjords.** A luxury snack or cocktail treat full of "Swiss" holes.
- **Seductive French "GRAPPE" coated with velvety black vintage grape seeds.** Chaste white-gold within — *a hedonist's delight!*
- **Rare Colonial WHITE CHEDDAR from Vermont** with NO color or chemicals. *Virgin uncut 3-lb. wheel for connoisseurs!*
- **Piquant snow-white Welsh CAERPHILLY** beloved of poet Dylan Thomas. *Ideal on crusty black bread with hearty ale!*

AND TRY THESE SPECIAL DELIGHTS!

· Spicy ROQUEFORT from France · Creamy HAVARTI from Denmark · Robust PARMIGIANO from Italy · Golden BUTTERKAESE from Germany · Exotic CHIBERTA from Basque country · Mellow DUNLOP, the "Scottish Cheddar" · Rich caramel-hued GJETOST from Norway · LAPPI from Finland · BRIE from France · ZOMMA from Turkey · and hundreds more!

**Tyrophile: a Greek-derived word meaning (what else?) cheeselover; what our Club members call each other.*

LOOK AT THESE BENEFITS!

FREE *"Concise Encyclopedia of the World's Great Cheeses."* Everything You've Always Wanted to Know About Cheese But Never Knew Where to Find in One Place! The 100 most wanted (and delicious) cheeses displayed by country and type, with quick-reference tables on flavor, color, sizes, shapes, usable "life," how to serve and store, buying tips, matching cheese to food and wine — PLUS a treasury of drawings, photos, cartoons, anecdotes, recipes and extensive GLOSSARY OF FOREIGN & TECHNICAL CHEESE WORDS.

FREE *"How to Hold a Successful Cheese and Wine Tasting."* Short, simple, sound advice — and so much fun to follow.

FREE *"How to Love and Care for Your Fine Cheeses."* No-nonsense do's and don'ts for serving, wrapping, cutting, freezing, melting, etc.

FREE *"How to Throw a Fondue Party at Home."* Classic continental recipes and shortcuts for a few guests to an army.

FREE *"Cooking-with-Cheese Recipe Guides."* Exciting sauces, soups and salads. Savory meat, fish and game dishes. Lavish buffets, barbecues, picnic treats, champagne suppers, etc.

FREE Lifetime subscription to the *"Overseas Arrivals Option List."* Profusely illustrated "insider's" newsletter. Mailed to you date-limited by U.S. Post Office and unavailable outside the trade except to Club members. Features latest shipments and just-arrived dockings of rare and popular cheeses. Order them *direct* through Club — no middleman. Some "specials" as low as 3c to 4c above importer's wholesale! Each cheese illustrated, described by type, flavor, origin, etc. in fascinating 1000-word essays.

FREE *Gourmet Consultation* — your personal questions answered graciously by experts.

FREE *Gourmet Utensils and other Surprise Gifts* with special orders.

PLUS *Cheese and Wine Tasting* invitations.

AND *Lovely Christmas and Holiday Gift Packages* beautifully wrapped from foreign lands to solve all your personal and business gift needs.

No obligations, only benefits

Membership does not obligate you to buy anything. To join, mail coupon with membership fee of only $5. *This is good for life — never another fee!* It helps defray acquisition and programming your name into computer fulfilment network that makes our Club and your benefits possible. Hurry — cheese "season" getting into full swing! Send to: **CHEESELOVERS INTERNATIONAL, Dept. ADX-6, 25 W. Merrick Rd., Freeport, N.Y. 11520.**

Club Membership is a WONDERFUL GIFT! Enclose names and addresses of each recipient on separate sheet with $5 for each name. Gift Members get all Club benefits plus free gift. We enclose handsome gift card signed in your name.

Mail to: Cheeselovers International, Dept. ADX-6, 25 W. Merrick Rd., Freeport, N.Y. 11520

YES, enroll me in CHEESELOVERS INTERNATIONAL. Here is my low $5 member fee. *It is good for life* (never another fee!) and entitles me to order cheese "DIRECT" at special member prices. I will also receive, at once, my *Concise Encyclopedia of the World's Great Cheeses,* subscription to the *Overseas Arrivals Option List; Wine-and-Cheese Tasting Guide; Fondue Party Guide; Cheese Care Guide; Recipe Cooking Guides;* etc. Membership does not obligate me to buy anything, ever. And I may return any purchase for a full refund—no questions asked. If not happy with the Club, I may cancel by returning my club materials within 10 days for a full refund of my member fee.

☐ YES, send me free gift at left for prompt action.

________Initial here if retailer, or intend to resell cheese bought through Club at higher price.

Signature____________________

Name____________________

Address____________________

City__________State________Zip________

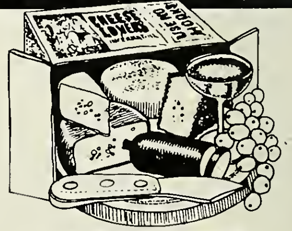
☐ Check enclosed or charge to my

☐ Master Charge Expiration Date (Located above your name)	☐ BankAmericard Interbank Number (Located above your name)

Your Card #____________________

**NOTE: Please don't order cheese now—wait for your special Club order forms to arrive.*

FREE GIFT FOR PROMPT ACTION



FIVE "MYSTERY" CHEESES

(1) New luxury Armignolt "raisin" cheese unveiled by *Fromagerie Picon de Paris.* (2) Zesty Dutch "finger" cheese almost half-a-foot long. (3) Sinfully delicious French dessert cheese wickedly laced with Kirsch (cherry brandy). (4) Hearty golden peasant cheese from Austria. (5) Creamy rich cocktail cheese from the Swiss Alps. KEEP THIS GIFT EVEN IF YOU LATER CANCEL.

NATURAL HISTORY

Incorporating Nature Magazine
Vol. LXXXIII, No. 1
January 1974

The American Museum of Natural History
Gardner D. Stout, President
Thomas D. Nicholson, Director

4 Authors

10 Miracle Seeds and Shattered Dreams
Richard W. Franke
If wishes were rice dishes, the Javanese would be more at ease.

20 This View of Life: Size and Shape
Stephen Jay Gould
Too often, science fiction movies ignore fundamental laws of design.

28 Solving the Moon's Riddles
Vivien Gornitz and Robert Jastrow
If the man in the moon came tumbling down, we would still have a lot of questions to ask him.

40 A Banquet for the Birds
Richard M. DeGraaf and Jack Ward Thomas
Even in avian circles, a free lunch has serious implications.

46 The Starving Roots of Population Growth
Roy E. Brown and Joe D. Wray
Birth control alone will not solve one of the greatest human problems.

54 Trial by Fire
James M. Freeman
The faith of a village hung in the balance when the magician and the kalasi engaged in a power struggle.

64 Tents and Tactics of Caterpillars
William G. Wellington
Too many or too few leaders can be disastrous to a colony.

74 Sky Reporter: A Visitor from Outer Space
Kenneth L. Franklin

76 Celestial Events
Thomas D. Nicholson

78 Fish Are What They Eat
Allen Keast
The shape and position of a fish's mouth reveals a lot about his life in the deep.

82 Announcements

90 A Faint Image of the Wild World
A review by Homer Page
Can a large, expensive book ever replace a pair of hiking shoes?

95 Suggested Additional Reading

Cover: *Photographer Steven C. Wilson's moody portrayal of gulls on Cape Johnson, Washington, comes from a recent book that presents nature photography as an art form. Illustrated review on Page 90.*

Alan Ternes, Editor
Thomas Page, Designer
Board of Editors:
Sally Lindsay, Frederick Hartmann,
Christopher Hallowell, Toni Gerber
Carol Breslin, Book Reviews Editor
Florence G. Edelstein, Copy Chief
Karen Bierstedt, Copy Editor
Angela Soccodato, Art Asst.
Diane Pierson, Editorial Asst.
Lillian Gindea

Rosamond W. Dana, Publications Editor

Editorial Advisers:
Dean Amadon, Dorothy E. Bliss,
Mark Chartrand, Niles Eldredge,
Vincent Manson, Margaret Mead,
Thomas D. Nicholson, Gerard Piel,
Richard G. Van Gelder

David D. Ryus, Publisher
L. Thomas Kelly, Business Manager
Ernestine Weindorf, Administrative Asst.
Joyce E. Klutch

Robert E. Williamson, Production Manager

Ann Brown, Circulation Manager
Dinah Lowell, Assistant Manager
Joan Mahoney
Harriet Walsh

Harvey Oshinsky, Advertising Sales Manager
Gordon Finley
Harry R. Jeter
Vic Asselin
Eileen O'Keefe, Production
Kathryn Hotarek, Asst.

Publication Office: The American Museum of Natural History, Central Park West at 79th Street, New York, N.Y. 10024. Published monthly, October through May; bimonthly June to September. Subscriptions: $8.00 a year. In Canada and all other countries: $10.00 a year. Single copies $1.00. Second-class postage paid at New York, N.Y., and at additional offices. *Copyright © 1973 by The American Museum of Natural History. No part of this periodical may be reproduced without the written consent of* Natural History. *Manuscripts and illustrations submitted to the editorial office will be handled with all possible care, but we cannot assume responsibility for their safety. The opinions expressed by authors are their own and do not necessarily reflect the policy of The American Museum.* Natural History *incorporating* Nature Magazine *is indexed in* Reader's Guide to Periodical Literature.

Authors

Richard W. Franke's interest in Java's Green Revolution stems from his disillusionment at the way developed nations have aided poorer nations. Franke, who lived on Java from 1969 through 1971 while doing his doctoral research, teaches anthropology at Montclair State College in New Jersey. He is presently investigating the relationship between food production and the social and political structures of developing nations and is planning to study the sociology and ecology of the recent famine in West Africa.

For Vivien Gornitz, who has a Ph.D. in geology and mineralogy, the Apollo moon landings, which began in 1969, presented a rare opportunity to study the geologic history of a planetary body other than the earth. She has, accordingly, spent much of her time interpreting lunar photographs. Gornitz is a research associate at NASA's Goddard Institute for Space Studies in New York City and also teaches a course in planetary geology at Columbia University. While still in high school, she signed up for a trip to the moon, and says she still would like to go. Coauthor **Robert Jastrow** joined NASA at its formation in 1958. He is the founder and director of the Goddard Institute for Space Studies, which conducts research in astronomy, meteorology, and planetary science. Holder of a Ph.D. in physics, he is a professor of geophysics at Columbia and also teaches earth sciences at Dartmouth College. Among the books he has written are: *Red Giants and White Dwarfs* and *Astronomy: Fundamentals and Frontiers.*

Vivien Gornitz

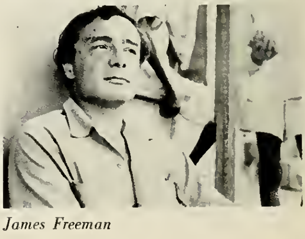
Roy E. Brown

It was while working as a pediatrician in several developing countries, and later in the rural southern United States, that **Roy E. Brown** first became aware of the connections between malnutrition, family size, and high fertility rates. Brown, who received his medical degree from Columbia University, is an assistant attending pediatrician at Mount Sinai Hospital in New York City and associate professor in the hospital's Department of Community Medicine. Coauthor of "The Starving Roots of Population Growth," **Joe D. Wray** is a member of the Bio-Medical Sciences field staff of the Rockefeller Foundation. He now lives in Thailand, where he is an adviser to the comprehensive rural health program of the Ramathibodi Teaching Hospital in Bangkok. Wray's major interests are pediatric education and delivery of health services to children in developing countries, preschool child nutrition, and family planning.

Richard M. DeGraaf, a wildlife biologist with the Pinchot Institute of Environmental Research of the U.S. Forest Service, began a study two years ago of the habitat requirements of songbirds in urban and suburban areas. Intrigued by his findings concerning the relationships between wild birds and people, he extended his research to include the widespread practice of bird feeding and its effect on bird populations and distributions. As the project leader of the Northeast Forest Experiment Station of the U.S. Forest Service in Amherst, Massachusetts, **Jack Ward Thomas**, coauthor of "A Banquet for the Birds," supervised the research on wild bird feeding. He is now with the Range and Wildlife Habitat Laboratory of the Forest Service in LaGrande, Oregon.

Richard M. DeGraaf

James Freeman's observations of the annual fire-walking ceremony at Sunderpur, a fictitious name for a



James Freeman

Did you know your car could have built-in reflexes?

vehicle location sensor
automatic headlight dimmer
automatic anti-skid control
collision avoidance radar
electronic fuel control
automatic speed control
radar speedometer
automatic braking

Some drivers will always be better than others. But thanks to advances in electronic technology, all drivers will be better some day because their autos will have built-in reflexes.

Drivers will have electronic devices to control skidding, detect highway hazards, warn of malfunctions—all automatically.

Electronic improvement of the automobile is almost limitless. By 1980 auto manufacturers may be spending as much on solid state electronic systems as on engines. Even so, electronics should eventually lower the cost of running a car.

Today, RCA provides the auto industry with components for the new electronic ignition systems. Tomorrow, we will provide a variety of other advances—such as electronic devices to replace inefficient mechanical methods of fuel mixture, which will cut energy consumption and aid in emission control.

Electronics is creating ingenious new ways to enhance life. And RCA, which helped create the technology itself, is still pioneering the electronic way.

The electronic way

RCA

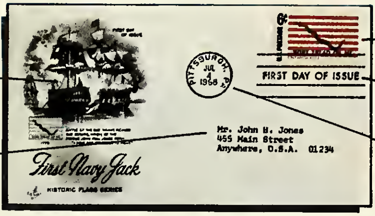
Readers of Natural History Magazine are invited to

POSTAL COMMEMORATIVE SOCIETY

Enjoy collecting a stirring panorama preserved for future generations.

- At a surprisingly modest cost, you can receive beautiful First Day Covers for each new commemorative stamp issue of the United States.
- Each First Day Cover will be individually addressed and sent automatically to the name and address you designate.

WHAT IS A FIRST DAY COVER?


6¢
U.S. POSTAGE
PITTSBURGH, PA.
JUL 4 1968
FIRST DAY OF ISSUE
Mr. John H. Jones
455 Main Street
Anywhere, U.S.A. 01234
First Navy Jack
HISTORIC FLAGS SERIES

Handsome "cachet" designed exclusively for each new issue, strikingly executed by steel engraving on the envelope.

Your own name and address is individually typewritten on every First Day Cover, and each is mailed directly to your own home.

Official U.S. commemorative postage stamp.

The authentic "one of a kind" First Day of issue cancellation, available only on that one day.

Postmark of the officially designated post office issuing the new stamp.

The United States regularly honors the important men, events and places in its history through the issuance of official U.S. commemorative postage stamps. When a new stamp is to be issued, one, and only one, post office is officially designated to provide . . . on one day only . . . the authentic "First Day" cancellation. The specially designed envelope bearing the new stamp, cancelled on the exact date of issue at the officially designated post office, is a First Day Cover.

First Day Covers are fascinating collectors' items. As you can well imagine, the combination of a historic stamp, cancelled on the first day of issue, at an officially designated post office on a specially designed envelope results in a collector's item of the first order. One that has been prized by collectors like Dwight D. Eisenhower, George C. Marshall and Franklin D. Roosevelt, plus others with the foresight to preserve yesterday and today for tomorrow.

The best time to obtain these prized collectors' items is when they are issued. This is now made easier than ever by the Postal Commemorative Society.

GENERAL DOUGLAS MacARTHUR COMMEMORATIVE
POSTAL COMMEMORATIVE SOCIETY
U.S. FIRST DAY COVERS
JOHN H. JONES

Postal Commemorative Society members receive everything they need to build and maintain a personalized "mint condition" collection of U.S. First Day Covers. For each cover issued, the Society provides an exclusive custom designed display page, especially made for the member's personalized album.

of U.S. history. To be treasured now and

FIRST DAY OF ISSUE
Centennial Baseball
JOHN J. AUDUBON
Salute to the AMERICAN INDIAN
MANS FIRST LANDING ON THE MOON
DANIEL BOONE
NASA
COMMEMORATING

First Day Covers combine art and history in a tribute to our American heritage. Eisenhower . . . The Battle of Bunker Hill . . . the writing of the Star Spangled Banner . . . the landing of astronauts on the moon . . . such are the subjects chosen by the United States for commemorative postage stamps. Nothing trivial or unimportant or dull is ever chosen for national honor.

Further, the post office chosen for a first day of issue usually bears particular significance to the subject commemorated. For example, a first day cover of the Eisenhower stamp was one cancelled at Abilene, Kansas.

The nation's leading artists and designers are called upon to portray the subjects chosen. Such commissions naturally are highly prized, and bring forth the best efforts of the artists involved.

Membership in the Postal Commemorative Society makes it possible to easily collect First Day Covers as they are issued. The Society will guarantee your receiving a personally addressed First Day Cover of every U. S. commemorative stamp issue. All details of arranging for your First Day Covers to be sent to you will be handled by the Society.

Commemorative stamps normally are issued by the United States at the rate of about 15 a year. You will receive up to this many issues at a basic cost of just $12.00 per year plus an annual membership fee of $7.50 (total yearly cost of $19.50).

As a member, you will also receive the Society's exclusive display page for each new issue. Each beautiful, specially designed page is die-cut to hold the First Day Cover, and contains a full description with all important historical information about the subject of the commemorative issue. *These pages are available only to members of the Society.*

Becoming a member now brings you an important collector's bonus at no additional cost. The Postal Commemorative Society makes available to its members a handsome collector's album with the member's name hand-embossed on the cover. This album, specially designed to hold the Society's display pages, makes it possible for members to keep each new First Day Cover in "mint" condition. *It is yours free, if you join now!*

MEMBERSHIP APPLICATION

NH

Postal Commemorative Society
1 Glendinning Place
Westport, Conn. 06880

Enclosed is $19.50* for a one-year membership, and First Day Cover Service. Send me the collector's album which is free to new members. My First Day Covers should be addressed as follows:

Mr., Mrs., Miss ____________________

Address ____________________

City ____________ State ____________ Zip ____________

Please emboss the personalized album as follows: ____________________
(Print name to be shown on album)

This is a ☐ Personal Membership
☐ Gift Membership
(If a gift membership, please provide your name and address on a separate piece of paper. A card announcing your gift will be sent to the member.)

*Connecticut residents add $1.27 tax. Make check or money order payable to Postal Commemorative Society.

Our Country's PRESIDENTS

INTRODUCTORY OFFER
AT AN INCREDIBLY
LOW SPECIAL PRICE:

The Presidents Medals

24 KARAT GOLD PLATE ON SOLID BRONZE

ACTUAL SIZE →

36 MEDALS WITH CASE $48

BONUS: "Our Country's Presidents," a National Geographic Society 275-page full-color book detailing the lives and accomplishments of our nation's leaders, is supplied to you at no additional charge.

Reserve my 36-medal set of pure gold-plate, solid bronze medals, each 30mm. Include handmade display case. I enclose full payment of $48, plus $1 for handling and shipping.
(Money refunded within 21 days if not fully satisfied.)

NH-1

NAME ____________________
STREET ADDRESS ____________________
CITY, ____________________
STATE, ZIP ____________________

Mail at once to: MintAmerica
Box 995 / 1470 NE 129th St. / N. Miami, Fla. 33161
Early orders shipped immediately; others allow 4-6 weeks.

The time has come to completely re-evaluate your standard of high fidelity performance.

The ingenious innovations in circuitry used in Pioneer's new TX-9100 AM-FM stereo tuner (1.5uV FM sensitivity) and SA-9100 integrated stereo amplifier (60+60 watts RMS, at 8 ohms, both channels driven) represent a major breakthrough that will have universal impact on all future hi-fi components. Their capabilities achieve performance and precision heretofore unattainable.

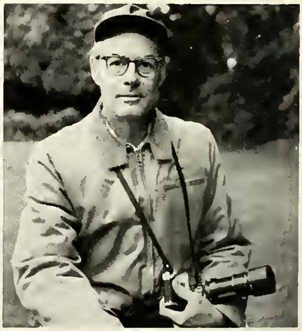
Your Pioneer dealer will demonstrate how they can outperform any units in their price range. TX-9100 — $349.95: SA-9100 — $449.95.

U.S. Pioneer Electronics Corp., 75 Oxford Drive, Moonachie, New Jersey 07074

PIONEER
when you want something better

village in the state of Orissa, India, grew out of his studies of religion in a Hindu temple village. Freeman, an associate professor of anthropology at San Jose State University, is currently completing a book, *Scarcity and Opportunity in an Indian Village,* on modernization and religious change in Orissa. He plans to edit a series of autobiographies he collected in India.

When William G. Wellington began insect population studies, he chose tent caterpillars because he thought their conspicuous tents would make them easy to survey. But determining how individual differences in behavior could affect the welfare of whole colonies led him and his students beyond population biology into the complex byways of sensory physiology and biometeorology. Wellington, who began his career in entomology in the Canadian Forest Service, is professor of plant science and resource ecology at the University of British Columbia.


William G. Wellington

After years of studying bird speciation in Australia, Africa, and South America, Allen Keast turned to the study of the feeding ecology of freshwater fish in small Canadian lakes. Operating out of Queens University in Ontario, where he is a professor of biology, he has spent thirteen years investigating how various fishes have developed their ecological specializations. Keast's research analyzes the factors that govern the numbers and kinds of fish in different waterways, a program that relates to his long-term interest in evolutionary ecology and species formation.

Now! Preview the great new
Deutsche
Grammophon
recording of the complete

FOUR SYMPHONIES OF BRAHMS

superbly conducted by CLAUDIO ABBADO

ALL 4 RECORDS FOR THE PRICE OF ONE

plus free auditions of important new recordings
months before they are available to the public!

Brahms' *Four Symphonies*—most magnificent since Beethoven's! The extraordinary new recording of them from Deutsche Grammophon offers Claudio Abbado conducting *four* of the world's greatest orchestras. This album will not be available to the American public for many months, but you may preview it now for ten days, without charge, without obligation. And you may keep all *four records for the price of one*—yes, a full 75% off the suggested list price at which they will eventually be sold in stores!

The Carnegie Hall Selection Committee's report accompanying the album points out why these performances were singled out for their recommendation: freshly conceived, deeply felt interpretations by young Claudio Abbado, Italy's foremost present-day conductor . . . the unprecedented opportunity for you to enjoy and compare four orchestras unsurpassed in precision, responsiveness and tonal splendor—the Vienna Philharmonic, Berlin Philharmonic, Dresden State Orchestra and London Symphony . . . plus Deutsche Grammophon's incredibly lifelike sound. The four stereo records themselves are superior, silent-surfaced European pressings, manufactured to highest quality control standards, and come in a handsome hinged case with illustrated brochure and *exclusive* Committee report.

Our preview offer of Brahms' *Four Symphonies* is limited! So please mail the coupon on this page today. Listen for ten days. Then either return the album and pay nothing, or keep it for only $6.98 plus small postage/handling charge (and sales tax where required). This is a saving of *$20.94 off* the suggested retail price when the regular edition is finally released.

How you can be first to enjoy the greatest new recordings!

By replying now, you assure yourself of the privilege of receiving, for future ten-day free previews, special *advance editions* of major new albums . . . chosen *exclusively* for the International Preview Society by the Carnegie Hall Selection Committee. Since the Society is *not* a record "club", you will never be required to buy any album, nor will you receive a "record-of-the-month" like clockwork. Only when the Committee discovers a new album of the most extraordinary musical interest, artistic excellence and technical quality will it be sent for your free audition, so that there will often be months when no album at all is offered by the International Preview Society.

In every case, you will preview these records *long before* they reach the stores . . . with the option of purchasing any album you wish, in a superb imported pressing, including exclusive Committee report . . . never at a higher price than the ordinary edition will retail for months later, and frequently at *big savings!* You may cancel this arrangement at any time.

If you truly love great music, please mail the coupon today for your exciting Brahms' *Four Symphonies* preview.

Johannes Brahms
4 SYMPHONIES
Vienna Philharmonic Orchestra
Berlin Philharmonic Orchestra
Dresden State Orchestra
London Symphony Orchestra
CLAUDIO ABBADO

Try it for ten days FREE.
No obligation to keep it!

All 4 records only
$6.98
(plus small postage/handling charge) if you decide to keep them after your free audition!

Fill out and mail this coupon today

FOUR-FOR-THE-PRICE-OF-ONE PRIVILEGE

THE INTERNATIONAL PREVIEW SOCIETY
333 North Michigan Ave., Chicago, Illinois 60601

Please send, for my free preview, the advance edition of Brahms' *Four Symphonies* by Claudio Abbado. I may return it after ten days and owe nothing, or keep all four records and pay only $6.98 complete, plus small postage/handling charge (sales tax extra, where required). This is *$20.94 off* suggested list price of the regular edition, when it becomes available months from now. I will also receive, at intervals of one or more months, free ten-day previews of albums chosen by the Carnegie Hall Selection Committee, far in advance of general release. I may keep any album for no more, and often for far less, than suggested list price. *I am not obligated to buy any minimum number of albums and I may cancel this arrangement at any time.*

NAME ____________________
(please print)

ADDRESS ____________________

CITY ____________ STATE ________ ZIP ________

Only new members eligible for this offer
Offer limited to U.S. and its possessions.
DNH

Miracle Seeds and

Shattered Dreams in Java

The Green Revolution may lead to larger harvests, but larger harvests do not always lead to full stomachs

by Richard W. Franke

RICHARD W. FRANKE

Each planting season in Java's mountainous regions, peasants must rebuild the dikes, irrigate the terraces, and transplant the rice seedlings.

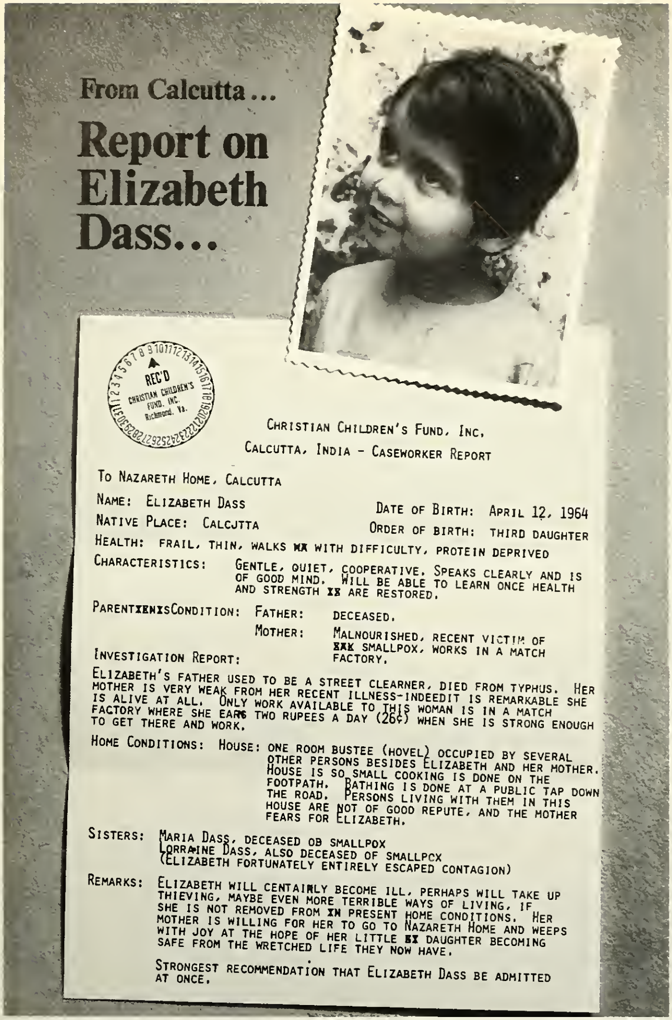
Culturally, politically, and economically, Java is Indonesia's most important island. It is also one of the world's richest agricultural regions. Streams, carrying an abundance of soil rich in nutrients, flow from the more than thirty active volcanoes along Java's central ridge. From time to time the volcanoes erupt, spewing out lava that eventually turns to fertile soil in the warm and humid valleys and on the coastal plains.

For hundreds of years Javanese farmers have ditched, terraced, plowed, planted, and weeded this marvelous confluence of natural elements to produce the rice on which their lives depend. So rich is the soil, so dependable the water supply, so excellent the climate, that for centuries the population has increased, and the land has supported not only farmers and their families but also princely dynasties, courts, traders, armies, and eventually even the industrial development of Java's recent colonial rulers, the Dutch.

But the outcome of the island's history has not been a happy one for Java's peasants. By the turn of the twentieth century, the strains of population growth and the expropriation of rice lands by Dutch sugar interests had begun to produce the paradox so common in the underdeveloped world today—increased profits for the wealthy few and a declining standard of living for the mass of producers. Throughout the depression of the 1930s, the Japanese occupation during World War II, the war for independence from the Dutch in the 1940s, and to the present day, this decline has continued. It has brought the people of Java to the verge of famine and created ever worsening conditions for the vast majority of the island's 80 million inhabitants.

With an annual per capita income of less than $80 in 1969, Javanese peasants are among the poorest in the world. Nutritional standards are declining at an alarming rate. In 1960 the average Javanese consumed 1,946 calories per day, 200 short of United Nations minimum recommendations. By 1967 consumption had dropped to 1,730 calories. Protein intake is declining as well. Minimum adult recommendations call for 55 grams of protein per person daily. In 1960 the Javanese consumed 38.2; by 1967 this had fallen to an average of 33.4, meaning that millions of the poorest farmers and laborers subsist at even lower levels.

In Javanese villages and in the sprawling urban slums of the island's largest cities, the results of this undernourishment are obvious even to the casual observer. Children stare dully, unable to focus properly. Many persons have reddish hair and distended bellies, both signs of various stages of malnutrition. High rates of influenza, dysentery, tuberculosis, and more recently, outbreaks of cholera



From Calcutta...

Report on Elizabeth Dass...

REC'D
CHRISTIAN CHILDREN'S FUND, INC.
Richmond, Va.

CHRISTIAN CHILDREN'S FUND, INC.
CALCUTTA, INDIA - CASEWORKER REPORT

TO NAZARETH HOME, CALCUTTA

NAME: ELIZABETH DASS DATE OF BIRTH: APRIL 12, 1964
NATIVE PLACE: CALCUTTA ORDER OF BIRTH: THIRD DAUGHTER
HEALTH: FRAIL, THIN, WALKS WX WITH DIFFICULTY, PROTEIN DEPRIVED
CHARACTERISTICS: GENTLE, QUIET, COOPERATIVE. SPEAKS CLEARLY AND IS OF GOOD MIND. WILL BE ABLE TO LEARN ONCE HEALTH AND STRENGTH XX ARE RESTORED.
PARENTXENXSCONDITION: FATHER: DECEASED.
MOTHER: MALNOURISHED, RECENT VICTIM OF XXX SMALLPOX, WORKS IN A MATCH FACTORY.
INVESTIGATION REPORT:

ELIZABETH'S FATHER USED TO BE A STREET CLEARNER, DIED FROM TYPHUS. HER MOTHER IS VERY WEAK FROM HER RECENT ILLNESS-INDEEDIT IS REMARKABLE SHE IS ALIVE AT ALL. ONLY WORK AVAILABLE TO THIS WOMAN IS IN A MATCH FACTORY WHERE SHE EARNS TWO RUPEES A DAY (26¢) WHEN SHE IS STRONG ENOUGH TO GET THERE AND WORK.

HOME CONDITIONS: HOUSE: ONE ROOM BUSTEE (HOVEL) OCCUPIED BY SEVERAL OTHER PERSONS BESIDES ELIZABETH AND HER MOTHER. HOUSE IS SO SMALL COOKING IS DONE ON THE FOOTPATH. BATHING IS DONE AT A PUBLIC TAP DOWN THE ROAD. PERSONS LIVING WITH THEM IN THIS HOUSE ARE NOT OF GOOD REPUTE, AND THE MOTHER FEARS FOR ELIZABETH.

SISTERS: MARIA DASS, DECEASED OB SMALLPOX
LORRAINE DASS, ALSO DECEASED OF SMALLPCX
(ELIZABETH FORTUNATELY ENTIRELY ESCAPED CONTAGION)

REMARKS: ELIZABETH WILL CENTAIRLY BECOME ILL, PERHAPS WILL TAKE UP THIEVING, MAYBE EVEN MORE TERRIBLE WAYS OF LIVING, IF SHE IS NOT REMOVED FROM XN PRESENT HOME CONDITIONS. HER MOTHER IS WILLING FOR HER TO GO TO NAZARETH HOME AND WEEPS WITH JOY AT THE HOPE OF HER LITTLE BX DAUGHTER BECOMING SAFE FROM THE WRETCHED LIFE THEY NOW HAVE.

STRONGEST RECOMMENDATION THAT ELIZABETH DASS BE ADMITTED AT ONCE.

Elizabeth Dass was admitted to the Nazareth Home, and when this picture was taken, she was already doing better. Her legs were stronger . . . she was running with the other children, learning to write her own name.

Every day desperate reports like this reach our overseas field offices. Then we must make the heartbreaking decision—which child can we help?

For only $12 a month you can sponsor a needy little boy or girl from the country of your choice, or you can let us select a child for you from our emergency list.

Then in about two weeks, you will receive a photograph of your child, along with a personal history, and information about the Project where your child receives help. Your child will write to you, and you will receive the original plus an English translation—direct from an overseas office.

Please, won't you help? Today?

Sponsors urgently needed this month for children in: India, Brazil, Philippines, Indonesia and Guatemala.

Write today: Verent J. Mills

CHRISTIAN CHILDREN'S FUND, Inc.
Box 26511, Richmond, Va. 23261

I wish to sponsor a ☐ boy ☐ girl in (Country)__________
☐ Choose a child who needs me most. I will pay $12 a month. I enclose first payment of $________. Send me child's name, story, address and picture.
I cannot sponsor a child but want to give $________.
☐ Please send me more information.
Name__________
Address__________
City__________
State__________Zip______
Registered (VFA-080) with the U.S. Government's Advisory Committee on Voluntary Foreign Aid. Gifts are tax deductible. Canadians: Write 1407 Yonge, Toronto 7. NH 7810

constantly plague a population physically too weak to resist disease. Cuts and burns heal with exasperating slowness, adding to the risk of infection. Even the body size of Javanese has been declining over the past fifty years, a result of the worsening diet. Java, it would seem, has received far too little help from the wealthy nations of the world.

Yet this island has been the object of one of the most elaborate food production schemes of the past two decades. Between 1967 and 1972 the government of Indonesia and its Western allies spent well over $100 million, mostly on Java, in an attempt to produce nationally 15.4 million tons of rice—the amount needed for self-sufficiency—by 1973. By the 1972 harvest, however, the program was clearly failing; the 12.2 million tons produced in that year were at least 2.1 million short of the need. With international food supplies at their lowest levels in years, the Indonesian government was able to purchase only 1.5 million tons abroad, leaving a 600,000 ton deficit, which in turn increased local rice prices by 30 percent in just a few months.

To make matters worse, the government has almost ignored soybean production, which has undergone an absolute decline, causing protein intake to drop even below the disastrous levels of 1967. In the countryside of Java and in the urban slums, this will mean a further decline in nutrition for an already badly undernourished people.

How has this tragedy come about? Why have all these millions in expenditures failed to stem further impoverishment among the majority of Javanese? The answers lie in the blindness of development theorists to the social and political realities of Java and in the nature of aid programs from the wealthy nations—programs based on these faulty theories.

The program that was to have overcome the food shortage on Java is called the Green Revolution. The product of more than two decades of scientific research, the program is part of a broad and optimistic experiment occurring in several developing countries. Under the auspices of the Rockefeller Foundation, a seed research laboratory was established in Mexico City in 1944. Within several years, technicians

AN EASY WAY TO CHANGE JOBS!

'My system is simple, straight forward and quick – but it works. Do it right and I guarantee the highest earnings of your career!'

I've got something that can help you earn a great new living and perhaps even make you rich!

Now, I know this seems hard to believe, but I can also *prove* it to you!

I say this because I've got letters from *thousands* of satisfied customers, ... and a product which has been praised by 150 leading media!

What's more, at $10, it's an incredible bargain, and I'll even give it to you without asking you to risk *one penny!*

However, first let me tell you what I have.

I've got a *copyrighted job changing system* that you can use to move up in your field, or out to another field, but at significantly higher earnings.

It took myself and five other professionals two years and $250,000 to develop–*but it works!*

Furthermore, it doesn't require "genius" and it doesn't require "luck." All you have to do is put it into action.

The reason we developed it was because with 84 million employed, and 15 million circulating resumes each year, this area was ready for some revolutionary ideas.

We knew more people than ever owned prestige cars & yachts, summer homes and international retreats, as well as having securities, real estate holdings and lots of cash in the bank.

In short, many people in the U.S. are living good lives!

At the same time, however, the great majority have no excess cash, little job security, and are frequently restless, bored with their jobs, commuting long hours, and harrassed by inflation!

We asked ourselves how do people get to live the "good life"?

Well, we found that most successful people were there because they never wasted time in dead-end situations!

What these people did was to make crucial job changes, and *parlay* their higher earnings into small fortunes!

Take a look at the economics!

Do you realize that if you were to change jobs every 4 years, at an average annual increase of $4,000, and then put the increases in the bank at 6%,–that in 20 years you'd accumulate an extra *half million dollars!*

Getting raises is one thing, but getting significant increases because of job changes is a very important source for wealth!

The next question then, is how can you easily change jobs? This is where the unique system we've developed fits in.

Our system can work for anyone from $8,000 to $80,000. Do it right and you'll gain higher earnings, lifelong job security, but most of all, *everlasting* self confidence!

This is because once you've used it, you'll know you can *always* get a new job,–quickly and predictably.

Perhaps you're wondering why our system works? Well, it works because it's a *completely different approach,* based on totally new concepts.

But, also because it's simple, practical, and self-tailoring. You could start next week–and do it *without strain, confusion or worry.*

But, there is one catch! You won't be a success if you use old methods for dealing with recruiters & agencies, for answering ads & sending out letters, for handling interviews & negotiating salary.

To make more money without a hassle, you'll have to be willing to change. You'll also have to follow our system, have an open mind & have faith in yourself.

However, do this and a better life will be yours!

With our system, whatever you seek–a better job, a new career, higher pay, more satisfaction,–*I believe nothing can stop your success!*

Not age, sex, education, or even low earnings or past working history.

Personnel Magazine said we have a *"breakthrough."*

Business Week devoted a full page article and called it *"indispensable."*

The National Public Accountant even said it was *"capable of catapulting any average person into a position offering much greater rewards."*

However, your best proof of our system is that we've already received thousands of letters from grateful customers.

Letters like one from a gentleman in Arizona who wrote, *"In 4 weeks I changed jobs and raised my salary 33%! I wish I had it 10 years ago!"*

Another man from New York said *"I used one of your letters, sent 24 out, and got 13 interviews and 3 job offers!"*

Still another from California said *"In just 11 days I received an offer of $7,000 more!"*

I know this sounds almost too easy and I can't promise that you will do as well. But, then again you may do better!

Even the largest business magazine in the U.S., **Nation's Business**, said our system was *"incredibly effective."*

Now, if you're serious about wanting to move up, then I know that our system is something you've got to have!

In fact, I'm so convinced that you'll agree that it's worth *hundreds of times the cost,* that I'll make sure you have nothing to lose.

First of all, when your order arrives, we'll ship within 24 hours. No delays!

Secondly, you can examine our system for 10 days.

Third, if at the end of that time you are dissatisfied, return it, & I personally guarantee your 100% refund will be mailed in 3 working days–with no questions asked!

To let me prove everything I've said, and to take advantage of this nothing-to-lose offer, just fill in and mail me the coupon below.

Performance Dynamics Inc.
Attn: Mr. Robert Jameson, President
17 Grove Avenue
Verona, New Jersey 07044

Dear Mr. Jameson:

Your offer sounds great! Please rush me your Professional Job Hunting System right away, but on one condition. I understand I may examine it for 10 days, & if at the end of that time I return it, you will mail my full refund within 3 working days, and with no questions asked. On that basis, here's my ten dollars plus fifty cents for postage and handling.

☐ Enclosed is my check or money order
☐ Chg. Bank Amer. ☐ Chg. Amer. Expr.
☐ Chg. Master Chg. ☐ Chg. Diners Club.

Acct. # Exp. Date

Name

Street

City State Zip

Please note: Shipment is via parcel post. For spec. del. add $1.50; for U.S. air add $3.50; for fgn.air add $7.00 nh

Mr. Jameson's ideas have been the subject of more than five hundred articles, ranging from 600 words in Business Week to 3,000 words in Chicago Today. This material has also been nationally advertised in leading media including The Wall Street Journal, Scientific American, Nation's Business, Signature, The New York Times, Newsweek International, The Los Angeles Times, American Scientist, Income Opportunities, Time, Specialty Salesman, Success Unlimited, Chemist, The Army Times, New York, The Chicago Tribune, True & others. © *1973 Performance Dynamics Inc.*

THE LIFE OF LINCOLN
Kentucky Birth

An important new offering from The Lincoln Mint*... limited to just ten thousand subscribers

The President

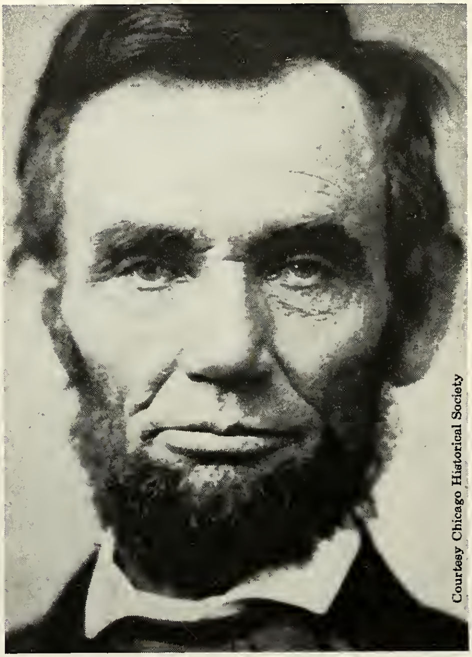
24 Rare Proof Medallions in Solid Sterling Silver and 24 Kt. Gold on Solid Sterling Silver . . . Available now by Subscription Only

He was a giant of a man—in stature, in the reach of his mind, the breadth of his humanity, the depth of his compassion. His very name has come to symbolize America's greatness as his features have come to symbolize America's strength.

His name was Abraham Lincoln.

He was a son of the Kentucky border, a man of the prairie frontier. He was called to the nation's highest office to preside over a tragic civil war he had struggled to avert. He was struck down by an assassin's bullet still striving to "... finish the work we are in; to bind up the nation's wounds . . ." Today his life and his words are among the richest treasures of our national heritage.

Since his death in 1865, Americans have raised many monuments to their 16th President—in masterworks of sculpture, in majestic public buildings. Now, there is to be *a unique* tribute to his memory: A series of 24 brilliantly wrought commemorative medallions depicting the great events in Abraham Lincoln's life issued by The Lincoln Mint in a limited edition heirloom collection.



Courtesy Chicago Historical Society

Distinguished Scholars Guide an Historic Issue

This series was guided from inception by the eminent Lincoln historian, Ralph G. Newman, and a group of distinguished Lincoln scholars. Medallic designs were created by Lloyd Ostendorf, the foremost Lincoln artist of our day. Medallions will be struck by The Lincoln Mint, recognized by numismatists as one of the nation's finest private mints. These Ostendorf designs will provide a superb medallic record of Lincoln's life from his log cabin birthplace in Hardin County, Kentucky, to his final resting place in Springfield.

Each medallion in the set will depict a great scene in the Lincoln legend in brilliant gold or silver. Each will bear your personal serial number. Each will be struck individually to assure its brilliant proof finish. Each will be a full 39 millimeters in diameter—larger than any coin the U.S. produces. Your complete set will contain more than two pounds of Solid Sterling Silver.

The Lincoln Mint has authorized only an extremely limited edition of these 24 Ostendorf designs. This limited edition will be *reserved exclusively for advance subscribers.*

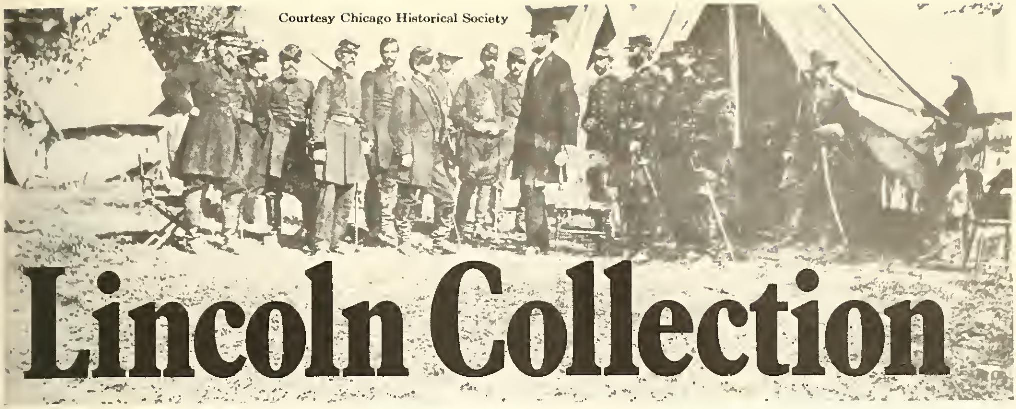
Limit: One Proof Set Per Subscriber

A limit of 5,000 reservations will be accepted for sets to be struck in Solid Sterling Silver, and 5,000 deluxe sets minted in Solid Sterling Silver and richly finished in 24 Kt. Gold. The low subscriber price is $11.50 for each Solid Sterling Silver Medallion and only $14.50 for each 24 Kt. Gold on Solid Sterling Silver Medallion.

You Must Reserve Promptly

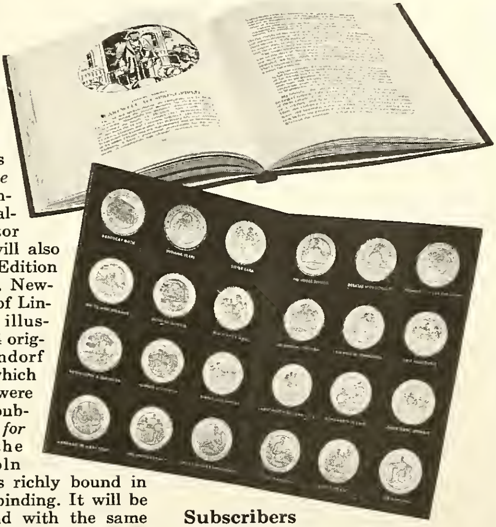
It must be emphasized that, regardless of total demand, only the first 5,000 subscriptions received for either can be honored. Applications received after the 5,000th set for each has been allocated will be returned. Reservations and subscriber serial numbers will be allocated on the basis of postmark date. An early postmark will result in a lower serial number on your medallions—which collectors feel will increase the subsequent value of your set. The earlier your reservation is postmarked, the greater your chance of acceptance.

An investment for today, an heirloom for future generations.



Courtesy Chicago Historical Society

Lincoln Collection



Included without extra cost: "THE LIFE OF LINCOLN" in his own words.

The President Lincoln Collection is something *more* than a set of commemorative medallions any collector will prize. You will also receive a Limited Edition copy of Ralph G. Newman's "The Life of Lincoln". Lavishly illustrated with the 24 original Lloyd Ostendorf drawings from which your medallions were designed, it is published *exclusively for subscribers* to the President Lincoln Collection, and is richly bound in a deluxe library binding. It will be inscribed by hand with the same personal serial number which identifies each medallion in your set.

The President Lincoln Collection comes to you in this beautiful album.

As a subscriber, you will receive a handsome display album in which to house your collection. Album pages, shown here, will facilitate mounting and display of each medallion you receive while protecting its fine proof-finish. Your album and your "Life of Lincoln" make up a unique two-volume set housed in a special hand-made case. Together they become a personal *Museum* of Lincolniana in your home—with your 24 medallions as its heart.

This is a limited offer . . . it will not be extended or repeated. Why risk missing this opportunity? Please cut out the coupon and mail it *today!*

Subscribers Are Protected by The Lincoln Mint Guarantee

Obviously, the beauty, craftsmanship, and limited edition status of The President Lincoln Collection would command wide collector interest under any circumstances. The gold and silver used to create The President Lincoln Collection have greatly increased in cost on the International Metals Market in recent months.

The Lincoln Mint guarantees that your subscriber's price per medallion will not be increased for the life of your subscription—regardless of rises in the International Metals Market.

Larger than the U.S. Silver Dollar! Medallions measure 39 millimeters in diameter. Extremely fine detail and depth of relief make all 24 scenes from Lincoln's life true masterpieces of medallic art.

THE LIFE OF LINCOLN
The Memorial

Actual size 39 mm.

SUBSCRIPTION INVITATION

The Lincoln Mint
One South Wacker Drive
Chicago, Illinois 60606

Please reserve in my name THE PRESIDENT LINCOLN COLLECTION, a series of 24 commemorative medallions in

Check one

- ☐ Solid Sterling Silver at $11.50 per medallion plus 45 cents for postage and handling.
- ☐ 24 Kt. Gold on Solid Sterling Silver at $14.50 per medallion plus 45 cents for postage and handling.

Also reserve in my name the limited edition volume, *The Life of Lincoln*, deluxe presentation album, and slipcase. I understand that I will receive one medallion each month, engraved with my personal number, registered exclusively to me. I agree to pay for each medallion promptly upon being invoiced, on a monthly prepayment basis. The Lincoln Mint guarantees that no more than 10,000 sets of THE PRESIDENT LINCOLN COLLECTION will ever be minted in these editions, and that my cost will not be increased regardless of price increases on the International Metals Market.

Enclosed is my check or money order in the amount of ________ for my first medallion (Illinois residents add 5% sales tax).

NAME________________________
(please print)

ADDRESS________________________

CITY________________________

STATE________________ ZIP________

LIMIT: ONE SET PER SUBSCRIBER

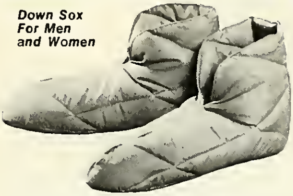
1303

*Not affiliated with any Governmental Agency.

Limited Offer-Mail Today!

Cloud-Soft Travelers

Down Sox For Men and Women



Tuck these Sox into a travel bag, wear them to bed, enjoy them as slippers or as inner sox for your insulated pacs or waders. Bauer Goose Down is quilted in soft, tough Nylon taffeta. **Colors:** Red, Winter Blue, Taupe, Powder Blue. **Sizes:** Specify men's or women's shoe size and we will supply proper fit. **0123** Sox, pair **$7.95** postpaid.

Order Today! Money Back Guarantee!
Enclosed is my check or money order for
$_______. (Add sales tax where applicable.)
Please RUSH my 0123 Goose Down Sox.
Men's Size________Color__________
Women's Size________Color__________
Name____________________
Address____________________
City____________________
State____________Zip________
☐ Send me FREE your new color catalog of over 1000 exciting outdoor products.

Eddie Bauer®

Dept ENH, 1737 Airport Way S, Seattle, Wa 98124

free wildlife prints

Join 60,000 League members who are creating a better environment. Membership entitles you to a free 10 x 13 inch limited edition wildlife print signed by artist-naturalist Charles J. Johnson, plus a year's subscription to *Outdoor America.*

Send $10 annual membership fee and selection of ruffed grouse or great horned owl numbered print to The Izaak Walton League of America, 1800 N. Kent St., Suite 806, Arlington, Va. 22209.

from the Izaak Walton League

had produced new varieties of corn and wheat with yield potentials far above those of local Mexican varieties.

By 1962 the Ford and Rockefeller Foundations united to establish the International Rice Research Institute at Los Banos, the Philippines, hoping the successes with wheat and corn could be duplicated with rice.

Sooner than expected, a genetic cross was achieved between a variety of rice from Indonesia and one from Taiwan. The result was a strain, IR-8, capable of doubling the yields of most local Asian rices. So profitable did the germ plasm from the new seeds seem that experts eagerly fostered their dissemination across the fields of southern Asia. By 1968, India, Pakistan, Thailand, the Philippines, Taiwan, South Vietnam, and Indonesia had begun large-scale planting of IR-8 and associated varieties of "miracle seeds."

With such a technological boon in hand, agricultural development planners began to revise their outlook on the development process. They now began to view as simpler, and more strictly economic, problems they had once seen as the results of psychological barriers, set up by "traditional" peasants unaccustomed to the idea of innovation, and institutional barriers, such as the outmoded labor and tenancy arrangements. If the new seeds could offer tremendous production increases at the level of the family farm, then perhaps all that was necessary to achieve their acceptance was the assurance that individual planters would earn a high rate of profit.

Such a position is represented in the highly influential study by Chicago economist Theodore Schultz, *Transforming Traditional Agriculture* (1964). In looking for ways to lower production costs to farmer-producers, thus increasing the profits from the farming enterprise, Schultz argues that if outside lending institutions can provide finances that will lower risk and if outside research and development organizations can pay for and even execute trials and experiments, then nothing should stand in the way of widespread acceptance of the new technology.

Economic planners were quick to take the cue from Schultz's proposals. During the 1960s, development programs and the discussions that surrounded them emphasized the construction of dams, irrigation works, harbors, markets, and roads. They advocated the provision of loans for fertilizer, pesticides, and above all, for new seeds.

With this new philosophy, the miracle of the Green Revolution should have been easily transmitted from the laboratory of the geneticist to become the major force for development in much of the impoverished world. Or so it seemed. The recent history of agricultural development programs on Java, however, reveals how poorly the theory and the seeds have fared.

Interest in agricultural development in Indonesia dates from the early 1950s. Reacting with a first flush of nationalism against the half-hearted agricultural extension system of the Dutch, the head of the national extension service proposed a way of intensifying contact between farmers and technicians. In each administrative unit, made up of about 15 villages, a five-acre farming plot was set aside where both farmers and technicians could experiment with different planting and growing techniques. Practical and imaginative in its conception, the program failed primarily for lack of government funds.

By 1959 planners had fashioned a new program. This experiment, known as the "paddy center," consisted of large areas of almost 2,500 acres each, served by a central facility for credit, fertilizer, seed distribution, and education. The program began to show signs of failure by 1962–63, chiefly because rice produced in these centers had to be sold to the government, and the government kept its price lower than the open market price. Farmers resented the loans, while planners felt that they were too easily available and were undermining the farmers' "sense of responsibility."

As the government continued to introduce new but ineffectual programs, some Javanese farmers took the initiative for change into their own hands. Under pressure from a growing movement of peasant and workers' associations, the government was forced to pass a series of land reform acts, beginning in 1960. Within months, however, the makeup of local land reform committees was so embroiled in politics

Diners Club makes it easy right from the beginning!

Use the form below to apply for your Diners Club card. Just detach and fold it, and it becomes a postage-paid envelope, pre-addressed to Diners Club, all ready to mail.

Please note: In order to be considered for membership in Diners Club, applicants must have an income of at least $10,000 per year.

DINERS CLUB 20-105-991
10 Columbus Circle, New York, N.Y. 10019
[PLEASE PRINT ANSWERS TO ALL QUESTIONS]

FOR OFFICE USE ONLY

1. ☐ Personal Account—bill residence ☐ Personal Account—bill office ☐ Company Account—bill office

2. ☐ Mr. ☐ Ms. ☐ Mrs. ☐ Miss

First Name Middle Last

Date of Birth Month Day Year

Spouse (first name)

Number of Dependent Children

Social Security Number

Home Address Street City State ZIP Code

Years at Present Address

Own Home ☐ Rent ☐

Telephone (include area code)

Previous Home Address Street City State ZIP Code

Years there

3. Firm Name or Employer

Nature of Business

Position

Address Street City State ZIP Code

Telephone (include area code)

Years with firm

Annual Earnings $ NOTE If annual earnings are less than $10,000 indicate source of other income below

Amount and Source of other Income

Previous Employer (if employed by above less than 3 years) or College/University if Recent Graduate

Yrs with firm or yr. graduated

Spouse's Employer

Address

Position

Annual Earnings $

Name and Address of Personal Reference (not living with you)

4. Name of Bank City & State Acct. Number

Type of Account: ☐ Checking ☐ Savings ☐ Loan

Name of Bank City & State Acct. Number

Type of Account: ☐ Checking ☐ Savings ☐ Loan

Other Credit Accts: ☐ Carte Blanche ☐ Master Charge ☐ American Express ☐ Bank Americard Other:________

Department Store Accounts

1________

2.________

Oil Company Accounts

1________

2.________

Former Diners Club member? ☐ Yes ☐ No

5. $17 FEE: covers 12 months' membership from date card is issued at $15 plus 1 year's subscription to Signature, the Diners Club Magazine, at $2. Subscription optional. Indicate choice below. Do **NOT** enclose check—we will bill you later. ☐ $17 Fee (Includes Signature Magazine) ☐ $15 Fee (Membership Only)

Send me an additional Diners Club Card at $7.50 for a member of my immediate family.

First Name Middle Last Signature of Add-on applicant Relationship

Please send me________forms for additional cards for members of my firm/family.

Signature of Individual Applicant Date

Signature of Company Officer for Authorization of Company Account Title

Applicant authorizes exchange of credit information, the issuance of credit cards as indicated and renewal and replacement thereof. Applicant agrees that each cardholder assumes joint and several responsibility for all charges with company applicant, if Company Account, or with primary applicant if Personal Account.

[HAVE YOU SIGNED THIS APPLICATION?]

DINERS CLUB
VALID WORLDWIDE
1234 56789 000 0
GEORGE T WORTHINGTON
VALID THRU SEP74
MEMBER SINCE 1954 IDC

FIRST CLASS
PERMIT NO.
59348
NEW YORK, N.Y.

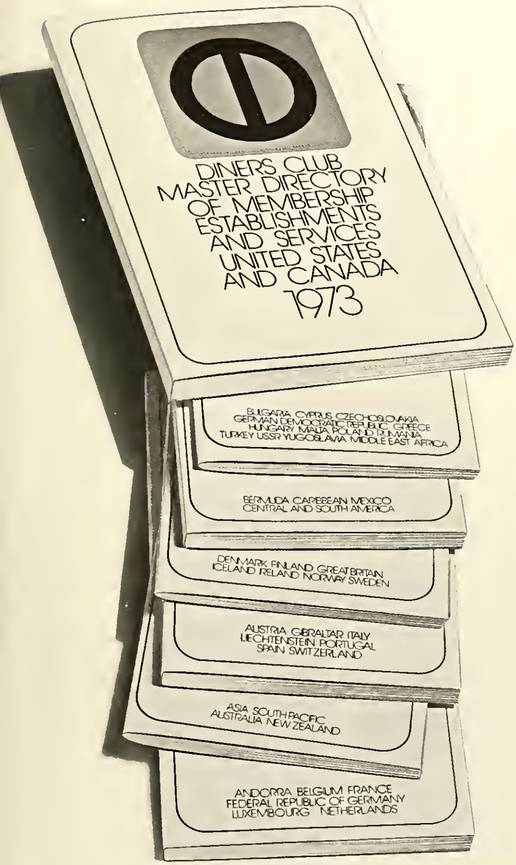
BUSINESS REPLY MAIL
No Postage Stamp Necessary if Mailed in The United States

POSTAGE WILL BE PAID BY

DINERS CLUB
10 COLUMBUS CIRCLE
NEW YORK, N.Y. 10019

The fact is, over 75,000 more establishments honor Diners Club than American Express.

(Carte Blanche is a distant third.)


DINERS CLUB
MASTER DIRECTORY
OF MEMBERSHIP
ESTABLISHMENTS
AND SERVICES
UNITED STATES
AND CANADA
1973
BULGARIA CYPRUS CZECHOSLOVAKIA
GERMAN DEMOCRATIC REPUBLIC GREECE
HUNGARY MALTA POLAND RUMANIA
TURKEY USSR YUGOSLAVIA MIDDLE EAST AFRICA
BERMUDA CARIBBEAN MEXICO
CENTRAL AND SOUTH AMERICA
DENMARK FINLAND GREAT BRITAIN
ICELAND IRELAND NORWAY SWEDEN
AUSTRIA GIBRALTAR ITALY
LIECHTENSTEIN PORTUGAL
SPAIN SWITZERLAND
ASIA SOUTH PACIFIC
AUSTRALIA NEW ZEALAND
ANDORRA BELGIUM FRANCE
FEDERAL REPUBLIC OF GERMANY
LUXEMBOURG NETHERLANDS

Diners Club exists for one reason and one reason only: to serve people who get around a lot.

That's why our card is honored throughout the United States, where we originated the travel and entertainment credit card.

And why, in Europe, you'll find us at 30% more places than American Express.

In Latin America, Asia and Africa, at more than three times as many.

The fact is, around the world, Diners Club has over 75,000* more member establishments than American Express. (Carte Blanche is a distant third.)

When you travel, those over 75,000 more places can mean a lot to you:

A charming out-of-the-way hotel that doesn't honor the other credit cards.

A locally recommended restaurant in a town you just "discovered."

A shop where they sell the kinds of things you just can't get at home.

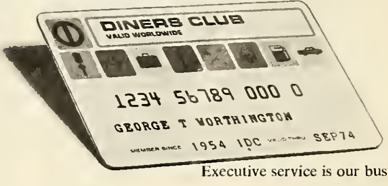
In fact, if you only have the other leading travel and entertainment credit card, it's like having *no card at all in 75,000 places.*

Because Diners Club is honored at so many more places, we do have to be a little more cautious than some of our competitors.

That means we often have to swallow hard and turn down applications they would gladly accept.

But, if you qualify, you'll find the rewards of Diners Club membership to be substantial indeed. Even if you already have another credit card.

Mail the application and see for yourself.


DINERS CLUB
VALID WORLDWIDE
1234 56789 000 0
GEORGE T WORTHINGTON
MEMBER SINCE 1954 IDC VALID THRU SEP74

Executive service is our business

Figures based on direct comparison of latest published Diners Club and American Express directories.

RICHARD W. FRANKE

Laborers crowd the edge of a large landowner's field hoping to be hired for the harvest. Police are often called to disperse such gatherings.

that other kinds of agricultural programs were also likely to become engulfed. By 1964, tensions between landowners and the landless had become so great that violent confrontations were frequently reported from the countryside.

With the peasants becoming involved in politics, an elite group within Indonesia's upper-class university system made their own plans. In 1963 some idealistic students and teachers at the College of Agriculture of the University of Indonesia, noting that their history of service to farmers and food production was somewhat less than illustrious, came up with the idea of personally aiding the farmers. The students planned to go into the villages, live with the farmers, teach and learn from them, and take their experiences back to a following group of students who would do the same.

The first year of the program was a heady success. Starting out in an area not far from the university, twelve students lived in three villages, worked in the fields with the farmers, offered suggestions for improved cultivation techniques, listened to farmers' points of view, and interceded with local government and private institutions on the farmers' behalf as only elite students—and perhaps radical political organizations—would dare to do at the time. Per acre yields rose 50 percent over regular plots, from 1,984 to 2,866 pounds per acre (before processing), and this happened before the introduction of the miracle seeds from Los Banos.

With only their own ideas, enthusiasm, and dedication, Indonesian students and farmers were doing with locally bred improved seeds what experts and advisers from outside were later to claim required the services of aid organizations, private foundations, and multinational corporations.

By the next rainy season, enthusiastic administrators from the Department of Agriculture had taken over the program from the university. More than 400 senior students from nine different schools lived and worked with farmers in more than 200 villages, amounting to 27,000 acres of paddy land. Despite difficulties in supplying some villages on time and some decrease in talent and enthusiasm due to the program's rapid expansion, another kind of success was achieved.

Students won the confidence of farmers as the government had never done. The potential of their actions showed itself in one village where local officials had stolen fertilizer intended for the project. The students responded by sending a well-documented letter to the officials threatening that if the fertilizer was not made available to the farmers, copies of the letter would find their way to even higher officials. The fertilizer came.

As the program expanded, it did not just involve greater numbers of students and farmers and larger amounts of land. Peasant leagues and radical political movements were growing in east and central Java, and the new program to increase rice production became entangled in the web of Indonesian politics. What the students at Indonesia's top agricultural college were discovering in their first few seasons with the farmers, Indonesia's Communist party had begun to learn and teach years earlier.

In 1953 the party had called for its workers to live in the villages and study the social and economic conditions there, working at the same time to win the confidence of smallholders and farm laborers. The program's slogan was the "three togethers": eat together, live together, work together; and organize to help small farmers and farm laborers overcome their fear of action. By these methods the party hoped to surmount what it considered the major obstacle to Indonesia's economic development—social and political control by a powerful ruling group.

At the same time the party was giving the farmers technological advice. In addition to attacking the powerful bureaucracy as "feudal remnants" and "imperialist forces," radical leaders urged farmers to adopt the "five principles": plow deeply, plant closely, use more fertilizer, improve seedlings, and improve irrigation.

The Communist party and student activists came to regard technology and strong political organizations for the poor as joint necessities in any attempt to bring about a more efficient use of resources on Java, both natural and human. Unlike most Western theorists, they rejected a simplified view of technology alone as the means to greater food production.

Continued on page 84

Stop Saying . . . "I Can't Afford To Travel"

7 BOOKS THAT GIVE YOU THE FACTS ON HOW YOU CAN TRAVEL TODAY WITHOUT BEING RICH

AROUND THE WORLD BY FREIGHTER

Where and how to travel by freighter —the lower cost way to travel

For no more than you'd spend at a resort, you can take a never-to-be-forgotten cruise to Rio or Buenos Aires. Or through the Canal or to the West Indies or to England, France, the Mediterranean, etc.

And what accommodations you get—large rooms with beds (not bunks), probably a private bath, lots of good food, and plenty of relaxation as you speed from port to port.

Travel Routes Around the World names the freighter lines (700 of them, with sailings from practically every port in the world), tells where they go, what they charge, briefly describes accommodations plus life on your freighter, clothes to take, etc.

To stop saying that travel is expensive get your copy now. Price $1.50.

AMERICA BY CAR

This big book is your insurance of seeing all the 4-star sights in whatever corner of the U.S., Canada, or Mexico you drive to. Whether you're visiting New England or California, Florida or the National Parks, the Great Lakes, the Mississippi, the East, the South, the Southwest, the Indian country, etc., it tells you day by day and road by road the scenic way to go and it always directs you to the important sights along the way and in the cities. In Niagara or Los Angeles, Washington or New Orleans, the Black Hills or Montreal, it takes the guesswork out of travel.

America is so big you can easily overlook or forget important sights or make many a wrong turn. So get *America by Car*, the book that makes sure you'll see everything of consequence and always travel right. Only $3.50 for this 170,000 word book (as big as 3 ordinary-sized novels).

FABULOUS MEXICO—WHERE EVERYTHING COSTS LESS

The land of retirement and vacation bargains—that's Mexico. Where an American retirement income looks like a fortune, and your vacation money can buy double or more what it might back home. Norman Ford shows you vacation and retirement values where you can live like a prince on what you might just get along on in the U.S.A. He pinpoints areas that look like the South Seas, others where it's like June all year round, towns where many other Americans have retired; shows where to find modern flower-bedecked hotels and inns that charge hardly half of what you'd expect to spend in even such a land of vacation and retirement bargains as Mexico. *Plus a big section where to start your money earning so much more than in the U.S.A. $2.50.*

OFF-THE-BEATEN PATH

—these are America's own Bargain Paradises

Where to retire or vacation at what look like prewar prices and no one ever heard of nerves or worries.

Off-the-Beaten Path names the really low cost Florida retirement and vacationing towns, the topnotch values in Texas, the Southwest, California, the South and East, Canada, and a dozen other areas which the crowds have not yet discovered:

—Fabulous places like that undiscovered region where winters are as warm and sunny as Miami Beach's, yet costs can be ⅔rds less. Or that island that looks like Hawaii yet is 2000 miles nearer. Or France's only remaining outposts in this part of the world . . . or a village more Scottish than Scotland . . . or resort villages without crowds or high prices . . . or island paradises aplenty in the U.S. or Canada . . . or areas with almost a perfect climate. And for good measure you also read about low cost paradises in Hawaii, the Virgin Islands, and Puerto Rico.

A big book, with about 100,000 words. Yet it costs only $2.50.

SPECIAL OFFER: All 4 books above—*Travel Routes Around the World, America by Car, Fabulous Mexico—Where Everything Costs Less,* and *Off-the-Beaten Path*—($10 value) for only $6.95.

DO YOU KNOW WHERE TO FIND

***The greatest retirement bargain in Florida? The most beautiful town in all California? The top-notch retirement communities in Arizona and New Mexico? The one place in the U.S. with the world's most perfect climate? The ideal island for retirement in the South with cool summers and warm winters. The one unspoiled retirement paradise in all the East?**

These are only a handful of the hundreds of beauty spots, hideaways, and other places in the U.S. where you can retire now on little money and enjoy yourself completely.

Where to Retire on a Small Income selects out of the thousands of communities in the U.S. and its island territories only those places where living costs are less, where the surroundings are pleasant, and where nature and the community get together to guarantee a good time from fishing, boating, gardening, concerts, or the like. The book never overlooks the fact that some people must get part-time or seasonal work to pad out their income.

It covers cities, towns, and farms throughout America—from New England south to Florida, west to California and north to the Pacific Northwest. It includes both Hawaii and the American Virgin Islands. Some people spend hundreds of dollars trying to get information like this by traveling around the country. Frequently they fail—there is just too much of America to explore!

Where to Retire on a Small Income saves you from that danger. Yet the big NEW edition costs only $2.50.

AMERICA'S MOST LIVEABLE, WORRY-FREE TOWNS

—where it's a pleasure to live and retire

Where to Retire on a Small Income covers them—America's most peaceful, worry-free towns, where you'll enjoy staying a while or retiring. Here are the places where you can walk freely, leave your home without worrying about holdups or robbery; here are none of the overwhelming problems of vast cities, the troubles we read about daily in our newspapers. Instead, this is the America we all seek—its peaceful, most liveable towns where it's really a pleasure to live and retire.

A good trip begins with a Harian book
Publishers since 1935

ALL ABOUT ARIZONA —the healthful state

Just as a road map shows you how to reach your destination, this big book leads you to whatever you want in the fast growing state of sun and scenic wonderlands.

What do you want to know about Arizona? Where to retire at low cost? Where are summers cool, winters sunny most of the time? Where are the leading places for a job, a home, etc.? What must a newcomer watch out for? Is it true that living costs are less than in the East? What about salaries?

Or do you want to tour this Grand Canyon State? What's the most scenic way to see Arizona by car or otherwise? What is really the most satisfying way to see the Grand Canyon? The Indian reservations? The other 4-star sights? Which are the sure ways to **cut travel costs** in this **big state?**

Filled with facts, over 100,000 words long, this book almost brings Arizona to your door answering these and a hundred other questions. To know all you should about Arizona before you go for a home, a job, retirement in the sun, or a really memorable vacation, read this book. Price $2.95.

WHERE WILL YOU GO IN FLORIDA?

Florida needn't be expensive—not if you know just where to go for whatever you seek in Florida. And if there's any man who can give you the facts you want, it's Norman Ford, founder of the world-famous Globe Trotters Club.

His big book, *Norman Ford's Florida*, tells you, first of all, road by road, mile by mile, everything you'll find in Florida, whether you're on vacation or looking over job, business, real estate, or retirement prospects.

Always, he names the hotels, motels and restaurants where you can stop for the best accommodations and meals at the price you want to pay. For that longer vacation, if you let Norman Ford guide you, you'll find a real "paradise"—Just the spot which has everything you want.

Of course, there's much more to this big book. If you want a home in Florida, he tells you just where to head. If you've ever wanted to run a tourist court or own an orange grove, he tells you today's inside story of these popular investments.

If you want to retire on a small income, Norman Ford tells you exactly where you can retire now on the money you've got, whether it's a little or a lot. Because he always tells you where life in Florida is pleasantest on a small income, he can help you to take life easy now.

Whatever you seek in Florida, *Norman Ford's Florida* gives you the facts you need to find exactly what you want. Well over 100,000 words but it costs only $3.00—only a fraction of the money you'd spend needlessly if you went to Florida blind.

Mail to HARIAN PUBLICATIONS,
279 Walnut Drive
GREENLAWN (Long Island), N.Y. 11740

I have enclosed $.........(cash, check, or money order). Please send me the books I checked below. YOU WILL REFUND MY MONEY IF I AM NOT SATISFIED.

- ☐ **Travel Routes Around the World** (travel by freighters). **$1.50.**
- ☐ **America by Car. $3.50.**
- ☐ **Fabulous Mexico—Where Everything Costs Less. $2.50.**
- ☐ **Off-the-Beaten Path. $2.50.**
  - ☐ SPECIAL OFFER #1. All 4 books above for $6.95
- ☐ **All About Arizona—the healthful state. $2.95.**
- ☐ **Norman Ford's Florida. $3.00.**
- ☐ **Where to Retire on a Small Income. $2.50.**
  - ☐ SPECIAL OFFER #2: All 7 books above $18.45 value—for $10.95.

Print Name ....
Street Address ....
City ....
State ....Zip Code ....

'Round The 'World
CRUISE
4 months for as low as
$3,105 First Class

- Beautifully appointed, all-air-conditioned 210- to 350-passenger cargo liners to Acapulco, Panama Canal, Port Everglades, Rio de Janeiro, Santos, Buenos Aires, Capetown, Durban, Lourenco Marques, Singapore, Hong Kong, Kaohsiung, Keelung, Kobe, Yokohama, Vancouver, B.C., San Francisco, Los Angeles. Monthly sailings.
- Up to 40 days in port gives you time for lengthy shore excursions.
- All accommodations are first class with private bath or shower.
- Swimming pool, spacious lounges, Continental and Chinese cuisine, full range of shipboard activities.
- No Age Limit. Doctor and nurse on board
- The M.V. Oriental Esmeralda and M.V. Oriental Carnaval are registered in Liberia. The M.V. Oriental Rio is registered in Taiwan

See your travel agent or contact
ORIENT OVERSEAS LINE
THE LEISURE LINE

General Passenger Agents
Orient Overseas Services, Inc.
510 Montgomery St., San Francisco, CA 94111
Please send me more information on your Round-The-World cruises.
Name
Address
City
State Zip
NH

"Why not stop basic research and apply what we already know?"

Eighteen noted specialists in science answer that question in

The Greatest Adventure
Basic Research that Shapes Our Lives

Edited by
EUGENE H. KONE and HELENE J. JORDAN
Introduction by ISAAC ASIMOV

Its four sections—Earth, Life, Health, and Civilization—tell how we and our planet mold each other: in population growth, pollution, energy problems, health, and communicating with others who share our world.

And they show how everyone of us is a part of science—that we and basic research form a partnership of progress.

In the words of Dr. Asimov, "Today's science is tomorrow's solution—and tomorrow's problems, too—and, most of all, it is mankind's greatest adventure, now and forever."

300 pp., illus., biographies of the authors, reading suggestions, index. *$9.80*

Order your copy from:
THE ROCKEFELLER UNIVERSITY PRESS
Box 269, 1230 York Ave., N.Y. 10021
Check enclosed: $8.80 including postage.
Please bill me: $9.80 plus postage.

Size and Shape

The immutable laws of design set limits on all organisms

Who could believe an ant in
theory?
A giraffe in blueprint?
Ten thousand doctors of what's
possible
Could reason half the jungle
out of being.

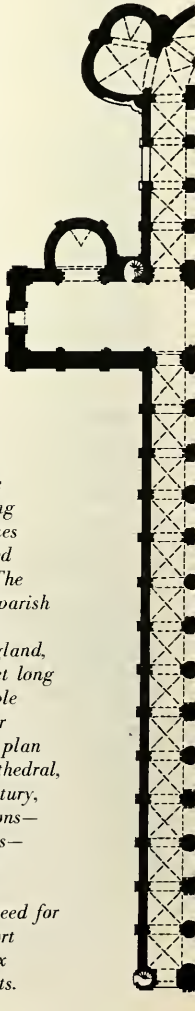
Poet John Ciardi's lines reflect a belief that the exuberant diversity of life will forever frustrate man's arrogant claims to omniscience. Yet, however much we celebrate diversity and revel in the peculiarities of animals, we must also acknowledge a striking "lawfulness" in the basic design of organisms. This regularity is most strongly evident in the correlation of size and shape.

Animals are physical objects. They are shaped to their advantage by natural selection. Consequently, they must assume forms best adapted to their size. The relative strength of such forces as gravity varies with size in a regular way, and animals respond by systematically altering their shapes.

The geometry of space itself is the major reason for correlations between size and shape. Simply by growing larger, an object that keeps the same shape will suffer a continual decrease in relative surface area. The decrease occurs because volume increases as the cube of length (length × length × length), while surface increases only as the square (length × length): in other words, volume grows more rapidly than surface.

Why is this important to animals? Many functions that depend upon surface must serve the entire volume of the body. Digested food passes to the body through surfaces; oxygen is absorbed through surfaces in respiration; the strength of a leg bone depends upon the area of its cross section, but the legs must hold up a body increasing in weight by the cube of its length. Galileo first recognized this principle in his *Discorsi* of 1638, the masterpiece he wrote while under house arrest by the Inquisition. He argued that the bone of a large animal must thicken disproportionately to provide the same relative strength as the slender bone of a small creature.

One solution to decreasing surface has been particularly important



The great range of designs among medieval churches can be attributed partly to size. The twelfth-century parish church of Little Tey, Essex, England, was only 57 feet long and had a simple floor plan, lower right. The floor plan for Norwich Cathedral, also twelfth century, shows adaptations—transept, chapels—required for the 450-foot-long building. The need for light and support dictated complex cathedral layouts.

by Stephen Jay Gould

in the progressive evolution of large and complex organisms: the development of internal organs. The lung is, essentially, a richly convoluted bag of surface area for the exchange of gases; the circulatory system distributes material to an internal space that cannot be reached by direct diffusion from the external surface of large organisms; the villi of our small intestine increase the surface area available for absorption of food (small mammals neither have nor need them).

100 Feet
50
40
30
20
10
0

Some simpler animals have never evolved internal organs; if they become large, they must alter their entire shape in ways so drastic that plasticity for further evolutionary change is sacrificed to extreme specialization. Thus, a tapeworm may be 20 feet long, but its thickness cannot exceed a fraction of an inch because food and oxygen must penetrate directly from the external surface to all parts of the body.

Other animals are constrained to remain small. Insects breathe through invaginations of the external surface. Since these invaginations must be more numerous and convoluted in larger bodies, they impose a size limit upon insect design: at the size of even a small mammal, an insect would be "all invagination" and have no room for internal parts.

We are prisoners of the perceptions of our size, and rarely recognize how different the world must appear to small animals. Since our relative surface area is so small at our large size, we are ruled by gravitational forces acting upon our weight. But gravity is negligible to very small animals with high surface to volume ratios; they live in a world dominated by surface forces and judge the pleasures and dangers of their surroundings in ways foreign to our experience.

An insect performs no miracle in walking up a wall or upon the surface of a pond; the small gravitational force pulling it down or under is easily counteracted by surface adhesion. Throw an insect off the roof and it floats gently down as frictional forces acting upon its surface overcome the weak influence of gravity.

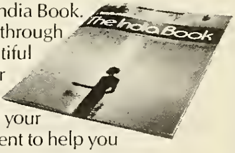
The relative weakness of grav-

Our free book of tours to India will free you from another ordinary trip to another ordinary place.

The India Book is a gift to you from Air-India. It's filled with extraordinary tours of an extraordinary land.

The tours in The India Book are as different as India is. Whatever the duration of your stay, price range or special interest, there's a special tour for you in The India Book.

You can be there this year. Send for The India Book. Wander through the beautiful full-color photos. Then see your travel agent to help you with your arrangements.



AIR-INDIA
666 Fifth Ave., N.Y., N.Y. 10019
Yes! I'd love a
free copy of The India Book.

Name

Address

City

State, Zip NH-1

We work all day to make your night with us a dream.

Magnificent color illustrations illuminate the phenomenon of color change in animal behavior

CHAMELEONS

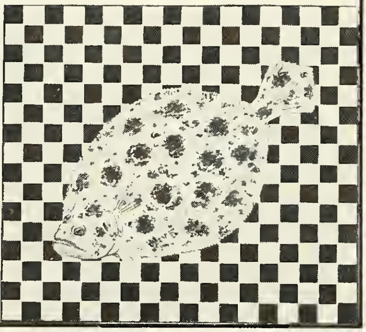
and Other Quick-Change Artists

by HILDA SIMON

The author-illustrator of the widely acclaimed *The Splendor of Iridescence* and many other popular books about nature has now used her rare artistic abilities to explore the capability of certain creatures to change colors rapidly. Her descriptive text explains how this change is a kind of language employed by certain animals to express anger, fear, contentment, or sexual excitement.

Large format/Thoroughly illustrated in color/$7.95
Quantity Discounts to Museum Shops

DODD, MEAD & COMPANY
79 Madison Ave., New York 10016



MAUPINTOUR TRAVEL ADVENTURES!

AFRICA UNHURRIED AIR SAFARIS

AN EASY PACE by comfortable, most modern safari cars and private aircraft for spectacular wildlife and scenic viewing. Small party, best accommodations. Game parks, tribal villages, cities, nature's wonders. Five different Deluxe Safaris: 20-day *East Africa Wildlife*, 22-day and 28-day *Africa Highlights*, 33-day *Southern Africa*, and 49-day *Grand Africa*.

ASK YOUR TRAVEL AGENT for the new *MAUPINTOUR AFRICA* tour book or write Maupintour, 270 Park Ave., New York, New York 10017. Telephone 212/687-7773.

our 23rd year of quality tour operation Maupintour

ASK ABOUT THESE MAUPINTOUR HOLIDAYS:
☐ Spain/Portugal ☐ Morocco ☐ Greece/Aegean Isles
☐ Middle East ☐ Egypt/Luxor ☐ Italy/Lakes/Sicily
☐ France ☐ The Alps ☐ Bavaria/Austria ☐ Balkans
☐ Germany/Rhine ☐ Middle Europe ☐ British Isles
☐ Dalmatia ☐ Scandinavia ☐ North Cape Adventure
☐ Europe Continental ☐ Soviet Union/Eastern Europe
☐ South Pacific ☐ Orient ☐ South America ☐ Africa

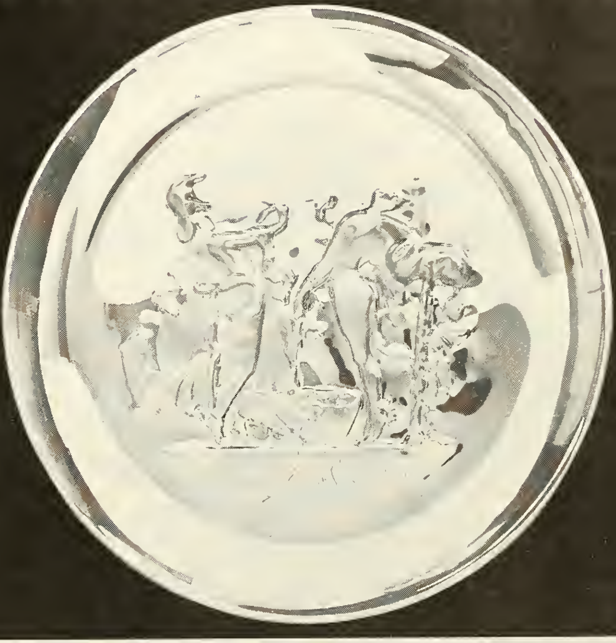
itational forces also permits a mode of growth that large animals could not maintain. Insects have an external skeleton and can only grow by discarding it and secreting a new one to accommodate the enlarged body. For a period between shedding and regrowth, the body must remain soft. A large mammal without any supporting structures would collapse to a formless mass under the influence of gravitational forces; a small insect can maintain its cohesion (related lobsters and crabs can grow much larger because they pass their "soft" stage in the nearly weightless buoyancy of water). We have here another reason for the small size of insects.

The creators of horror and science-fiction movies seem to have no inkling of the relationship between size and shape. These "expanders of the possible" cannot break free from the prejudices of their perceptions. The small people of *Dr. Cyclops, The Bride of Frankenstein, The Incredible Shrinking Man*, and *Fantastic Voyage* behave just like their counterparts of normal dimensions. They fall off cliffs or down stairs with resounding thuds; wield weapons and swim with olympic agility. The large insects of films too numerous to name continue to walk up walls or fly even at dinosaurian dimensions.

When the kindly entomologist of *Them* discovered that the giant queen ants had left for their nuptial flight, he quickly calculated this simple ratio: a normal ant is a fraction of an inch long and can fly hundreds of feet; these ants are many feet long and must be able to fly as much as 1,000 miles. Why, they could be as far away as Los Angeles! (Where, indeed, they were, lurking in the sewers.) But the ability to fly depends upon the surface area of the wings, while the weight that must be borne aloft increases as the cube of length. We may be sure that even if the giant ants had somehow circumvented the problems of breathing and growth by molting, their chances of getting off the ground would have been far worse than that of the proverbial snowball in hell.

Other essential features of organisms change even more rapidly with increasing size than the ratio of surface to volume. Kinetic energy, for example, increases as length raised to the fifth power. If a

DALI
THE GODS
DIONYSOS ET PALLAS ATHENA



A LIMITED EDITION WORK OF ART IN SOLID STERLING SILVER

Salvador Dali . . . Premier Artist of the surrealistic school has created a masterwork. in solid sterling silver. Coming to you in a limited edition of 10,000, "Dionysos et Pallas Athena" depicts Dionysos, god of wine and fertility and Pallas Athena worshipped as the goddess of wisdom and the arts. You will be thrilled at the exquisite detail and fine workmanship that combine to make this a most perfect work of art.

And any work of medallic art by Salvador Dali is exceptional art. Dali's first sterling silver plate, Unicorn Dionysiaque, was offered at $100 and is now trading for as much as $300. With utmost pride we offer this magnificent plate. Weighing more than 8 ozs. and measuring 8" in diameter, this masterpiece makes a precious treasure to cherish through generations.

The price of this truly superb piece is only $150 and the supply is limited. If you are interested in purchasing this masterwork, we urge you to act quickly . . . as the supply is rapidly diminishing.

N.H. 1

The Royal Mint • 581 Fifth Avenue • N.Y.C. 10017

I wish to purchase ____ Dionysos et Pallas Athena @ $150 plus $5 shipping & handling. (Limit 3 per order)

☐ Enclosed is my check in the amount of $________

☐ Bill my credit card $________ ☐ American Express

☐ BankAmericard ☐ Master Charge

# ____________ Expiration Date ______

Signature ____________

Name ____________

Address ____________

City ________ State ______ Zip ______

Experience. It shows.

Experience is what separates the men from the boys. Especially in automatic exposure cameras.

After all, it takes a lot of practice to make automation reliable in something as small and sophisticated as a fine camera.

Well, nobody has more experience than Konica.

The Konica Auto-S rangefinder cameras were introduced more than a decade ago. And immediately proved that automation wasn't the exclusive province of the novice.

Then Konica introduced the first automatic-exposure pocket-sized rangefinder 35, the C-35. And the first automatic-exposure professional single-lens reflex, the Autoreflex.

Now anyone can have automatic exposure 35mm photography. The professional, the amateur and casual picture taker. With Konica's extensive experience to back them. And razor-sharp Hexanon lenses up front. All at prices that anyone can afford. So go to your Konica dealer and see the difference experience makes. Or write for detailed literature.

Konica Camera Co., Woodside, New York 11377. In Canada: Garlick Films Ltd., Toronto

KONICA

Makers of world-famous
Sakura Color Print Films.

DIVISION OF Berkey PHOTO INC

KONICA C35
KONICA
AUTOREFLEX T
KONICA

Konica. The world's most experienced automatic cameras.

child half your height falls unsupported to the ground, its head will hit with not half, but only 1/32 the energy of yours in a similar fall. A child is protected more by its size than by a "soft" head. In return, we are protected from the physical force of its tantrums, for the child can strike with, not half, but only 1/32 of the energy we can muster. I have long had a special sympathy for the poor dwarfs who suffer under the whip of cruel Alberich in Wagner's *Das Rheingold.* At their diminutive size, they haven't a chance of extracting, with mining picks, the precious minerals that Alberich demands, despite the industrious and incessant leitmotif of their futile attempt.

This simple principle of differential scaling with increasing size may well be the most important determinant of organic shape. J.B.S. Haldane once wrote that "comparative anatomy is largely the story of the struggle to increase surface in proportion to volume." Yet its generality extends beyond life, for the geometry of space constrains ships, buildings, and machines, as well as animals.

Medieval churches present a good testing ground for the effects of size and shape, for they were built in an enormous range of sizes before the invention of steel girders, internal lighting, and air conditioning permitted modern architects to challenge the laws of size. The tiny, twelfth-century parish church of Little Tey, Essex, England, is a broad, simple rectangular building with a semicircular apse. Light reaches the interior through windows in the outer walls. If we were to build a cathedral simply by enlarging this design, then the periphery of the outer walls and windows would increase as length, while the area that light must reach would increase as length times length. In other words, the size of the windows would increase far more slowly than the area that requires illumination. Candles have limitations; the inside of such a cathedral would have been darker than the deed of Judas. Medieval churches, like tapeworms, lack internal systems and must alter their shape to produce more external surface as they are made larger.

The large cathedral of Norwich, as it appeared in the twelfth century, had a much narrower rec-

Exploding stars · concealed cities · seashells · snakes
Sooner or later all the natural world reveals its secrets to members of the

NATURAL SCIENCE BOOK CLUB

Just about every fascinating facet of the natural world comes under the scrutiny of The Natural Science Book Club in books sure to delight the eye, quicken the pulse, expand the intellect, transport the mind to times past and times beyond. You're but a reply card from enthralling adventure at welcome savings.

PRE-COLUMBIAN CITIES
Modern Cosmology
D.W. SCIAMA
The Fascination of Reptiles
Asimov's GUIDE TO Science
by Isaac Asimov
ISLAND AT THE CENTER OF THE WORLD

Retail prices in light
member's discount prices in bold.

44350. ELEMENTS OF CARTOGRAPHY: Third Edition. *Arthur H. Robinson and Randall D. Sale.* Comprehensive volume covers choice of scale and projection, flow maps, vector maps, graduated symbol maps, problems of three-dimensional rendering, as well as the arts of design and lettering. Techniques of reproduction and air mapping included. $12.75/**$8.50**

70240. PRE-COLUMBIAN CITIES. *Jorge E. Hardoy.* Vividly describes the little-known but bustling cities of pre-Columbian America — how they grew and decayed and how they hold a clue to the fate of our cities today. Illustrated. *Counts as 2 of your 3 choices.* $19.95/**$14.95**

32720. AMATEUR ASTRONOMY. *Patrick Moore, F.R.A.S.* Practical advice for beginners, technical data for students. Basic equipment, important techniques and a guide to the heavens — from asteroids to zodiacal lights! $6.95/**$5.95**

47340. EXPLORING THE OCEAN WORLD. Revised and Expanded Edition. *Edited by C. P. Idyll.* Richly illustrated volume is the non-professional's ideal introduction to oceanography. Explains continental drift, marine ecology, exotic underwater life, man's future in the sea, much more. $14.95/**$11.50**

48400. THE FASCINATION OF REPTILES. *Maurice Richardson.* A colorful and handsomely illustrated appreciation of these scientifically neglected and often maligned animals. Includes information on the care and feeding of reptiles. $10.00/**$7.75**

36141. BEYOND STONEHENGE. *Gerald S. Hawkins.* The author of *Stonehenge Decoded* assesses the significance of the temples of the Nile, Mayan ruins, the linear drawings in the Peruvian desert, and the huge geometrical earthworks of the U.S. $10.00/**$7.75**

Take any 3 Books FREE
(values as high as $45.50)
from the many adventures below with your First Selection
(at up to 30% discount)

as a new member of the Natural Science Book Club. You simply agree to accept only 3 more books—all at welcome discounts—over the next 12 months.

75060. SAFARI SOUTH AMERICA. *Christina Wood.* The dramatic, and sometimes dangerous incidents surrounding a jungle rescue mission to save several thousand wild animals trapped by the rising waters of a hydroelectric dam. $7.95/**$6.75**

86841. WHAT YOU NEED TO KNOW ABOUT FOOD AND COOKING FOR HEALTH. *Lawrence E. Lamb, M.D.* An eminent cardiologist offers a new and scientific approach to nutrition and how it can improve health through diet. $10.00/**$7.75**

62801. MODERN COSMOLOGY. *D. W. Sciama.* "This book is a masterpiece. From the standpoint of readability, orderliness, and its ability to hold one's attention, it is three standard deviations above the mean. It is almost unbelievably up to date."—*Physics Today* $9.95/**$7.95**

56530. ISLAND AT THE CENTER OF THE WORLD. *Father Sebastian Englert.* Easter Island's mysterious giant statues, the islanders' puzzling past, their lost language—new light is shed on them all here by the man who was the island's priest for 35 years. Illustrated in full color. $15.00/**$10.95**

38011. CITIES AND GEOLOGY. *Robert F. Legget.* The first geological work to take up the special problems of urban areas. A must for scientists, engineers, planners, and architects. $15.50/**$11.95**

60551. MARINE AQUARIUM KEEPING. *Stephen Spotte.* The science, animals and art of today's fastest growing hobby. Sound, sensible help on getting started, reliable, practical advice on maintaining a veritable living laboratory and a host of untold wonders before your eyes. Illustrated in color. $9.95/**$7.95**

63061. MOONS AND PLANETS. *William K. Hartmann.* An outstanding introduction to current knowledge of the solar system. "A masterpiece of factual information. Deserves the widest circulation among astronomers, geologists, and laymen alike because it has no equal . . ." — Clyde W. Tombaugh in *Mercury.* $12.95/**$9.95**

34630. ASIMOV'S GUIDE TO SCIENCE. *Isaac Asimov.* The incomparable Asimov does it again with this exciting general account of modern science — an encyclopedic work of 945 pages meant to be enjoyed. $15.00/**$11.50**

34710. AT THE TURN OF THE TIDE: A Book of Wild Birds. *By Richard Perry.* Engrossing accounts, both dramatic and amusing, of shore birds. Graphic descriptions of the "languages" and personalities of each species—heron, kestrel, cormorant, the charming puffin, and hosts of others. $7.50/**$6.25**

35751. BEGINNER'S GUIDE TO ARCHAEOLOGY. *Louis A. Brennan.* The techniques that will enable anyone to find, survey, test, excavate, preserve, analyze and record artifacts and other evidences of prehistoric life. Includes state-by-state lists of existing sites and restorations, laws, etc. $9.95/**$7.75**

86070. WANDERING LANDS AND ANIMALS. *Edwin H. Colbert.* A boldly original epic history of our planet's drifting continents and the spread of animals through the ages. Replete with charts, tables, maps, illustrations and impressive glossary. Recounts the finding of *Lystrosaurus* in Antarctica, now regarded as keystone evidence to explain continental drift. $12.50/**$9.75**

52170. HANDBOOK FOR PROSPECTORS. *Richard M. Pearl.* In the absence of a grizzled old prospector, the next best thing for the weekend rockhound is this all-inclusive guidebook to the where, when and how of prospecting. $14.50/**$11.25**

62060. MEN, BEASTS AND GODS: A History of Cruelty and Kindness to Animals. *Gerald Carson.* Harrowing and revealing history of man's frequently paradoxical relationship with animals . . . the cruelty, worship and exploitation with which past and present cultures have dealt them. $8.95/**$7.25**

If card is missing, simply write
Natural Science Book Club
Dept. 4-73A, Riverside, N.J. 08075
and indicate 3 books you want.

VOCABULARY RECORDS

VOCABULARY STUDIES
Dr. Bergen Evans VOCABULARY STUDIES

Listen and learn 2000 new words!

Two brilliant educators have taken the work out of increasing your word-power! In the comfort of your living room, listen to hundreds of the most diverse and stirring words in the English language—used in model sentences cut on records! Quickly grasp the meaning and pronunciation, use words you never used before.

Dr. Bergen Evans, famous word expert, wrote the script: Dr. Robert Breen, speech professor, brings it to life in living sound. Thrill to almost 4 hours of mind-bending, tongue-tickling vocabulary growth without dull dictionary reference.

5 Extras

At no extra cost, you receive 5 deluxe Study Manuals with superb word essays, quizzes, complete record script. Challenging, fun like a game for adults and children. Hi-quality vinyl records play on monaural or stereo equipment.

10-DAY FREE TRIAL

To: Registrar's Office,
Vocabulary Studies,
555 E. Lange St., Dept. 804-80
Mundelein, Illinois 60060.

☐ Please send me the Vocabulary Album which includes 5 12" Bergen Evans Records, 5 Study Manuals and handsome album case for my free examination. Within 10 days after receipt, I will either return everything or pay $4.95 monthly, only $29.70 total.

☐ I am enclosing $24.95 total cash price, postage paid. 10-day return privilege with money back if not satisfied.

Name__________
Address __________
City__________ Phone __________
State__________ Zip__________

tangular nave; chapels have been added to the apse and a transept runs perpendicular to the main axis. All these "adaptations" increase the ratio of external wall and window to internal area. It is often stated that transepts were added to produce the form of a Latin cross. Theological motives may have dictated the position of such "outpouchings," but the laws of size required their presence. Very few small churches have transepts.

I have plotted periphery versus the square root of area for floor plans of all postconquest Romanesque churches depicted in Clapham's monograph of English ecclesiastical architecture. As we would predict, periphery increases more rapidly than the square root of area. Medieval architects had their rules of thumb, but they had, so far as we know, no explicit knowledge of the laws of size.

Like large churches, large organisms have very few options open to them. Above a certain size, large terrestrial organisms look basically alike—they have thick legs and relatively short, stout bodies. Large Romanesque churches are all relatively long and have abundant outpouchings. The invention of the flying buttress strengthened later Gothic buildings and freed more wall space for windows. Churches could then become relatively wider and simpler in outline (as in the Cathedral of Bourges).

The "invention" of internal organs helped animals retain the highly successful shape of a simple exterior enclosing a large internal volume; and the invention of internal lighting and structural steel has helped modern architects design large buildings with simple exteriors. The limits are expanded, but the laws still operate. No large Gothic church is higher than it is long, no large animal has a sagging middle like a dachshund.

I once overheard a children's conversation in a New York playground. Two young girls were discussing the size of dogs. One asked: "Can a dog be as large as an elephant?" Her friend responded: "No, if it were as big as an elephant, it would look like an elephant." I wonder if she realized how truly she spoke.

Columnist Stephen Jay Gould teaches geology at Harvard University.

Discover Galapagos

For the discriminating traveler the only way to see the unique Galapagos Islands is on our leisurely two-week cruises in the twelve passenger schooner Golden Cachalot* with its superb British crew of eight. These cruises operate all year round.

For budget-minded travelers who are interested in ecology, wildlife and photography, we also offer our special Galapagos Islands Thrift Cruise from June 9 to 22, 1974 in the privately chartered 70-passenger mv Iguana*, accompanied by Mr. Brian Davies, Executive Director of the International Fund for Animal Welfare, Inc.

Brochures on both programs are available from:

HANNS EBENSTEN TRAVEL, INC
55 WEST 42 STREET, NEW YORK, NY 10036
TELEPHONE (212) 354 6634

* both ships are registered in Ecuador

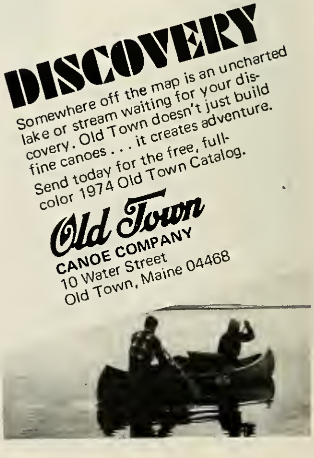
FOR HUMMINGBIRDS ONLY!

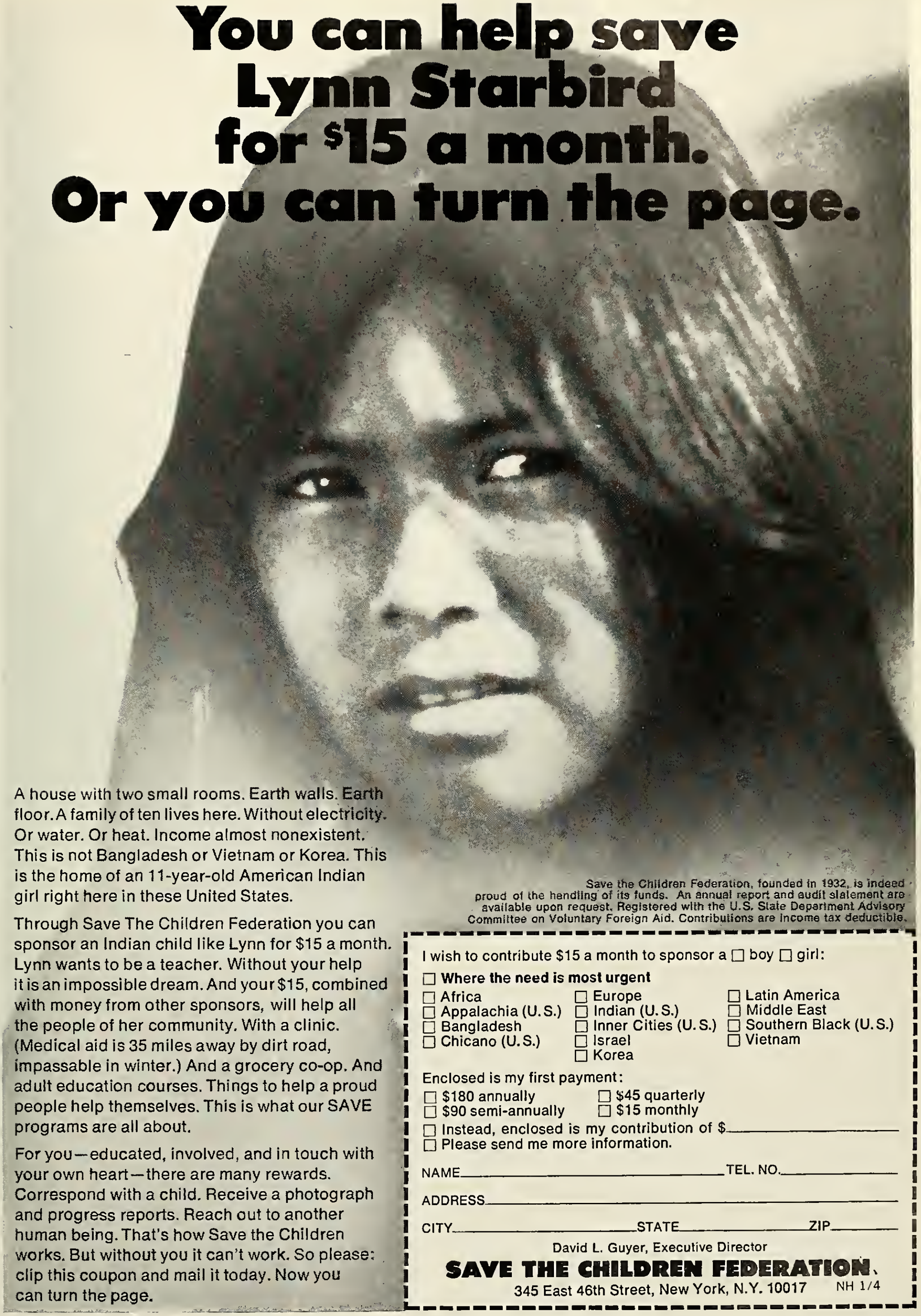
Hang an original "Hummy-Bird Bar" ® in your garden and watch 'em line up for a treat! Hummers can dine four-at-a-time. (actual photo) Glass bottle with 4-way plastic cup. Detachable perch. Beeproof. No drip or rust. Guaranteed. Instructions. $3.50 plus 50¢ ea. pstg & hdlg. Add 18¢ tax in Calif. Sorry, no CODs. HUMMINGBIRD HEAVEN, 10726-N Samoa Ave., Tujunga, Calif. 91042. Makers of the "Fun Bar" for orioles. Our 18th year. Made in U.S.A.

DISCOVERY

Somewhere off the map is an uncharted lake or stream waiting for your discovery. Old Town doesn't just build fine canoes . . . it creates adventure. Send today for the free, full-color 1974 Old Town Catalog.

Old Town
CANOE COMPANY
10 Water Street
Old Town, Maine 04468





You can help save Lynn Starbird for $15 a month. Or you can turn the page.

A house with two small rooms. Earth walls. Earth floor. A family of ten lives here. Without electricity. Or water. Or heat. Income almost nonexistent. This is not Bangladesh or Vietnam or Korea. This is the home of an 11-year-old American Indian girl right here in these United States.

Through Save The Children Federation you can sponsor an Indian child like Lynn for $15 a month. Lynn wants to be a teacher. Without your help it is an impossible dream. And your $15, combined with money from other sponsors, will help all the people of her community. With a clinic. (Medical aid is 35 miles away by dirt road, impassable in winter.) And a grocery co-op. And adult education courses. Things to help a proud people help themselves. This is what our SAVE programs are all about.

For you—educated, involved, and in touch with your own heart—there are many rewards. Correspond with a child. Receive a photograph and progress reports. Reach out to another human being. That's how Save the Children works. But without you it can't work. So please: clip this coupon and mail it today. Now you can turn the page.

Save the Children Federation, founded in 1932, is indeed proud of the handling of its funds. An annual report and audit statement are available upon request. Registered with the U.S. State Department Advisory Committee on Voluntary Foreign Aid. Contributions are income tax deductible.

I wish to contribute $15 a month to sponsor a ☐ boy ☐ girl:

☐ **Where the need is most urgent**

☐ Africa
☐ Appalachia (U.S.)
☐ Bangladesh
☐ Chicano (U.S.)
☐ Europe
☐ Indian (U.S.)
☐ Inner Cities (U.S.)
☐ Israel
☐ Korea
☐ Latin America
☐ Middle East
☐ Southern Black (U.S.)
☐ Vietnam

Enclosed is my first payment:

☐ $180 annually
☐ $90 semi-annually
☐ $45 quarterly
☐ $15 monthly

☐ Instead, enclosed is my contribution of $________
☐ Please send me more information.

NAME____________ TEL. NO.________

ADDRESS____________

CITY________ STATE________ ZIP________

David L. Guyer, Executive Director

SAVE THE CHILDREN FEDERATION

345 East 46th Street, New York, N.Y. 10017 NH 1/4

Solving the Moon's Riddles

by Vivien Gornitz and Robert Jastrow

With data from the Apollo missions, scientists are gradually piecing lunar history together

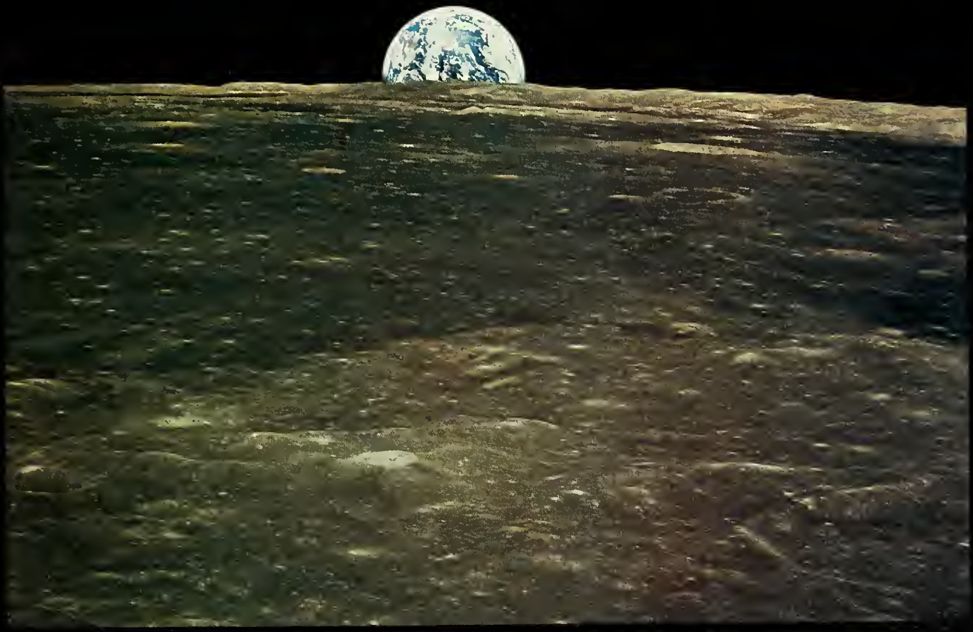
A feeling of intense excitement gripped the scientists at the Lunar Receiving Laboratory in Houston, Texas, as they waited in July, 1969, for the lid to be lifted off the first box of lunar rocks retrieved by man. From study of the rock samples brought back by astronauts of the Apollo missions, scientists hoped to acquire significant information about the moon's history and, by analogy, fill in a gap of a billion years in the earth's geologic chronicle. In addition, it might finally be possible to settle a long-standing dispute between proponents of a "hot moon" theory and those of a "cold moon" theory.

For a number of years, it has been known that the earth and its satellite, the moon, are similar in some ways. The moon is grouped with the terrestrial planets, namely Earth, Mars, Venus, and Mercury, because it has a higher density than the giant planets, such as Jupiter and Saturn, and because it is composed chemically of silicates, whereas the giant outer planets consist mainly of hydrogen and helium gases. Both the moon and the earth are presumed to have formed about 4.6 billion years ago, along with the rest of the solar system. But the moon is only one-quarter the diameter of the earth and has only one-eightieth of the earth's mass. Because of its relatively small mass, the moon has only one-sixth the gravitational pull of the earth and therefore cannot retain water or any appreciable atmosphere. Whatever gases and water vapor may once have existed on the moon have since drifted away into space. Despite these differences, the moon is more like the earth than the satellites of Jupiter are akin to that planet.

Clearly visible on the lunar surface, even to the naked eye, is the pattern of light and dark areas that make up the face of the "man in the moon." When Galileo first directed his telescope toward the moon in 1609, he discovered that the dark areas were smooth, while the light areas were rugged and mountainous. Not knowing that the moon lacked water, he equated its dark areas with the earth's oceans and the light highland regions with earth's continents.

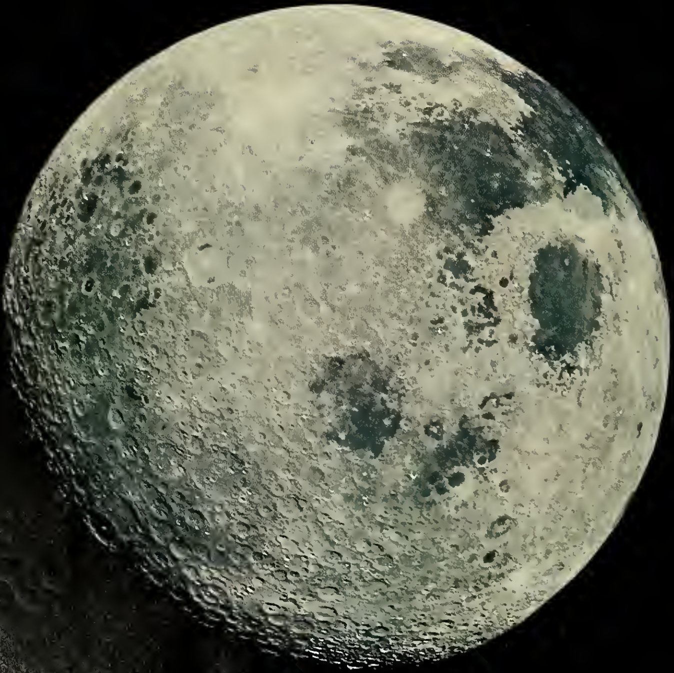
Accordingly, he called the dark lunar regions *maria* (Latin for seas), and the name has persisted even though it is now known that the moon is today a dry planet and has probably been dry throughout its history.

ALL PHOTOGRAPHS FROM NASA

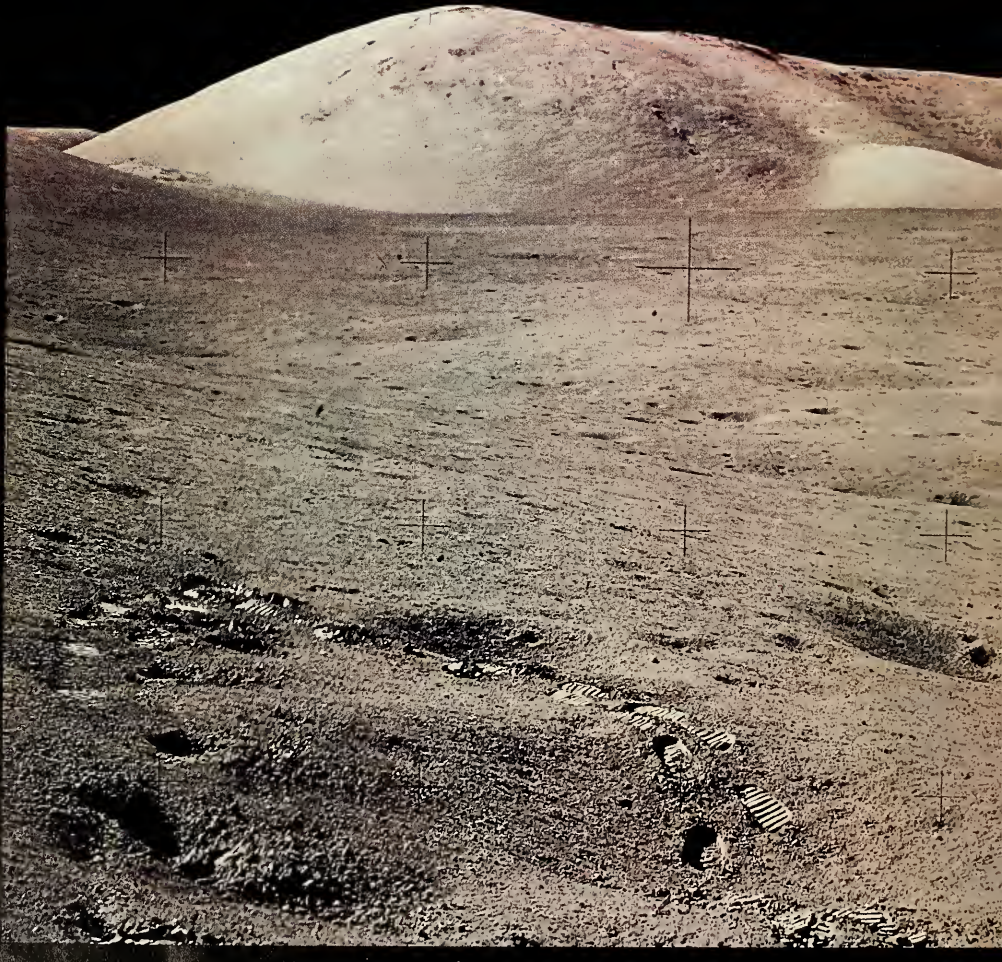


Astronauts of the Apollo 11 mission watched
the earth rise over the moon's horizon.
Cloud formations and oceans could be distinguished
despite the 225,745-mile distance.

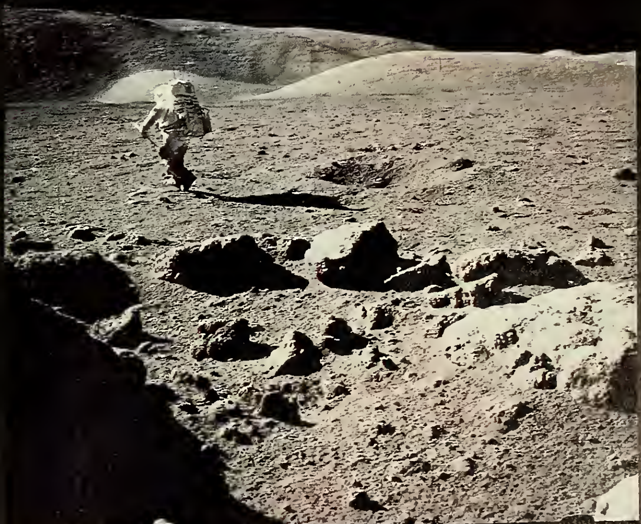
The command module of Apollo 17, right, remained in orbit around the moon after releasing the lunar module for landing. In addition to performing experiments, the command ship photographed the far side of the moon, never seen from earth. This new view, the right third below, shows that the back of the moon lacks the maria, or dark areas, and is more heavily cratered than the familiar lunar surface.



32



The astronauts' footprints in the Taurus-Littrow valley, site of the Apollo 17 landing, left, may last at least a million years. Because of the moon's relatively weak gravitational pull, only one-sixth that of the earth, astronauts tended to bounce when walking, below.



A specially designed lunar rover was used on Apollo 17 for collecting rock and soil samples at an extended range from the landing site. Powered by two silver zinc, 36-volt batteries, the vehicle had an electric engine for each of its four wheels.

The crescent earth, as seen from the moon by Apollo 17's astronauts, almost appears to have a face.

The most striking aspect of the moon's appearance is the abundance of craters on its surface. They range in size from circular basins 1,000 kilometers (about 620 miles) in diameter down to craters measuring less than a few meters or feet across. The majority of these craters have been produced by a continuous rain of meteorites over the eons. The moon's surface rocks also contain microscopic depressions ("zap pits") caused by the solar wind, cosmic particles, and micrometeorites, from which the earth is protected by its atmosphere.

The earth too has been subjected to meteorite bombardment, but its early surface has been obliterated by the erosive action of winds and running water and by the movement of tectonic plates, with accompanying mountain-building activity and volcanic eruptions. These forces have churned the earth's surface and flooded it repeatedly with fresh lava flows. As a result, only the scars of the most recent collisions, such as Meteor Crater in Arizona, formed about 30,000 years ago, are still visible. Because the forces that have altered the face of the earth are absent on the moon, large areas of the lunar surface have preserved a record dating back nearly to the time of the moon's formation. The oldest rocks on the earth's surface go back only 3.5 billion years, but some of the rocks picked up at Apollo lunar landing sites are more than four billion years old. It is assumed that after their original accumulation both the moon and earth were subjected to an intense meteorite bombardment, which resulted in the early melting of their surfaces. Moon rocks, being so much older than earth rocks, can therefore shed light on the missing first billion years of the earth's geologic history.

Before the manned Apollo missions, from 1969 through 1972, when knowledge of the moon came primarily from telescopic observation, two schools of thought gradually developed regarding the history of the moon. Advocates of the first viewpoint believed that the moon passed through a period of partial or complete melting at some point in its history and is probably still partly molten today. This hot moon school held that the moon is a differentiated body like the earth, meaning that it too is partitioned into a small molten core, a mantle, and a crust, with various minerals concentrated at different depths. This school of thought saw evidence of extensive and continuing volcanism on the moon's surface. Partisans held the moon to be interesting precisely because it was similar to the earth and would permit application of geologic principles to the unraveling of the history of another body. The second school of thought in lunar geology believed the moon was formed cold and has remained so ever since. According to cold theorists, the moon is a relatively rigid and geologically inactive planet. Unlike the earth, it is believed to be undifferentiated, with its iron distributed evenly throughout the interior. The moon's cratered surface was ascribed entirely to external meteorite bombardment, with no signs of volcanism or internal activity. The moon, according to this viewpoint, is a primitive body that has preserved the early record of the solar system.

The landing sites for the Apollo missions were carefully selected to settle, if possible, the contradiction between these theories. Among the six missions that actually landed, the first two were confined to the lunar maria, others aimed for the highlands, and the balance were targeted for areas of more varied terrain such as rills, or narrow valleys, and mare embayments. In addition to rocks gathered at these sites for laboratory analysis, various experiments designed to provide further information about the moon's interior were conducted on the planet's surface and from lunar orbit.

The rocks from the two landings made by Apollo 11 and 12 at Mare Tranquillitatis and Oceanus Procellarum, respectively, turned out to be basaltic lava similar to a widespread type of volcanic rock found on the earth, both on the ocean floors and on the continents. Subsequent landings confirmed that essentially the same type of igneous material covered all the lunar maria. These rocks thus came to be known as mare basalts.

Basalt is a volcanic rock, not a primitive planetary material. Its presence suggests internal melting with subsequent extrusion of the molten magma. This evidence accordingly favored the hot moon theory and tended to establish the moon as a differentiated body.

While many scientists had anticipated that the maria were pools of congealed lava, they were surprised at the composition of rocks collected later from the lunar highlands. Highland material, it had been thought, was the primordial, undifferentiated, unmelted substance of the moon. Instead, the highland rocks also turned out to be igneous material of basaltic composition. (Most highland rocks are actually breccias, or rocks composed of fragments of pre-existing rocks. The fragments themselves, however, are basalt. This implies that a uniform layer of molten rock once covered the highlands, before the lunar surface was fragmented.) The highland basalts, as these rocks were labeled, are however quite distinct from the mare basalts in mineral content and chemical composition.

The minerals found in the mare basalts consist predominantly of pyroxene and plagioclase feldspar, which are also the most common minerals of terrestrial basalts. Lesser amounts of olivine and ilmenite are also present. While olivine appears in mare basalts in about the same concentration as in terrestrial basalts, ilmenite, an iron titanium oxide, is unusually abundant, particularly in rocks from the eastern half of the moon.

An unexpected finding was the presence of a large amount of titanium in the mare rocks. Common terrestrial igneous rocks contain less than 1 percent of titanium, but the moon rocks near Tranquillity Base contained more than ten times as much. Why this rare metal should be more abundant in the moon's basaltic rocks than the earth's remains unexplained.

In highland basalt, plagioclase is the predominant mineral, while pyroxene and olivine occur in reduced amounts. Ilmenite is merely a trace mineral, making up less than 1 percent of the total.

Detailed studies have shown that the highlands consist of several distinct kinds of rocks, including one given the chemical shorthand name of KREEP, a rock rich in potassium (K), rare earth elements (REE), and phosphorus (P), with traces of thorium and uranium. Although present in varying proportions over most of the moon, KREEP is a major constituent of the Apollo 14 Fra Mauro material. Other highland rocks have a very high content of plagioclase feldspar. Such rocks, called anorthosite, are found in ancient Precambrian terrains on the earth but are not as widespread here as on the moon.

A few minerals that are unknown on earth were found in the mare basalts. These include armalcolite, whose name is derived from the beginning initials of the three pioneering Apollo 11 astronauts, Armstrong, Aldrin, and Collins; and tranquillityite, named for the mare in which it was found.

During the last three missions, Apollo 15, 16, and 17, instruments aboard the command module, which remained continuously in lunar orbit, performed experiments and collected data about the whole moon. Among the instruments used was an X-ray fluorescence spectrometer, which measured the concentrations of aluminum, magnesium, and silicon in the surface rocks. The data from this experiment demonstrated that the few scattered samples collected by the astronauts were truly representative of large parts of the moon and confirmed that the highlands contained up to twice as much aluminum as do the maria. Aluminum is a major element in plagioclase feldspar.

Laboratory analyses showed the lunar rocks to be uniformly bone dry. They contained no traces of water, either in the form of moisture or as water molecules locked into the crystal structures of the minerals. Nor did they reveal any trace of organic matter. No residues of living organisms; no amino acids, the basic molecular building blocks of all known forms of life; or other prehistoric precursor molecules of life were detected except in amounts so small as to suggest contamination from an experimenter's fingerprint. This dryness, combined with the scarcity of carbon, suggests that life as we know it never existed on the moon and never will, for water more than any other substance is essential for the support of life.

The moon has also been found deficient in volatile elements—those with low boiling points. Among these are sodium, potassium, chlorine, germanium, lead, and mercury. The depletion of sodium and potassium is particularly striking since these two elements are among the ten most abundant substances contained in terrestrial rocks.

The lunar soils—mineral fragments, rock fragments, and glassy beads—taken from the six landing sites are all about 4.6 billion years old. While this age does not necessarily refer to the time elapsed since the material crystallized, it does suggest that the chemical elements underwent a differentiation process shortly after the moon formed. That is, widespread melting probably occurred, during which certain elements became concentrated near the surface while others accumulated at greater depths. What could have caused a melting of the outer layers of the moon at such an early period? Probably a great deal of heat was generated from the gravitational energy released by the rapid accretion, or accumulation, of the moon. At that time, the moon's surface was also being pelted by a violent hailstorm of meteorites, asteroids, and other debris left over from the formation of the solar system. This intense bombardment may have sufficed to melt the outer regions of the moon. The earth's surface may also have suffered a similar fate, but the record has been erased by subsequent geologic activity.

An important consequence of this early lunar melting was the formation of a low-density crust rich in plagioclase, overlying a denser mantle of pyroxene and olivine. The ancient highland crust presumably developed in this fashion. Several million years would have been required for the crust to cool sufficiently to preserve a permanent record in the rocks, which would explain why the oldest rock specimen yet recovered from the moon, found at the Descartes site of Apollo 16, is only 4.25 billion years old. If that rock is not exceptionally old but is representative of all the moon's highlands, it then follows that the surface of the moon solidified at least 4.25 billion years ago.

Most highland rocks, however, range in age from 3.8 billion to 4.1 billion years. But the nature of the events recorded by the crystallization ages in highland rocks is not completely clear. For example, many highland rocks from different and widely spread localities have ages that cluster at about 3.9 billion to 4.0 billion years. This clustering of ages implies the occurrence of some phenomenon that affected rocks over large parts of the moon at exactly the same time. Did a series of catastrophic events take place simultaneously? Prof. Gerald J. Wasserburg of CalTech, an expert in the dating of lunar rocks, has proposed that such events might have been collisions of asteroid-sized objects with the moon's surface, the force of which blasted out Mare Imbrium, for example, and possibly other large, circular impact basins as well. The period of intense meteorite collisions may have ended abruptly 3.9 billion years ago—a much later date than formerly believed.

All the mare basalts dated thus far are younger than 3.8 billion years, which supports photographic evidence that the maria are younger than the highlands. The mare basalts range in age from 3.8 billion to 3.1 billion years. Apparently, the period of time during which the moon was a billion to one and a half billion years old was one in which extensive floods of lava inundated several widely separated regions on its surface. The relatively late date at which these mare lavas appeared strongly suggests that they were melted by internal igneous activity, triggered off by the heat of radioactive decay of radioisotopes of uranium, thorium, and potassium. Calculations show that the rates of heating by these radioactive elements would require about one billion to one and a half billion years to raise the temperature of the moon's interior to the melting point.

The youngest rocks found on the moon are about three billion years old. Thus it appears that geologically very little has happened to the moon in recent years.

Why did the lava flows cease three billion years ago? Perhaps the moon, being a small object, lost its heat to space at a fairly rapid rate. As the moon's heat disappeared and its internal temperature dropped, the boundary region of warm and partly molten rock receded into the interior, and the outer zone of cold, solid rock became thicker. The present state of calm, contrasted with an early, short, violent history may provide the basis for reconciling the opposing views of the cold and hot moon theorists.

Among the scientific instruments left on the moon's surface to collect data were seismometers set up at five seismic stations. They have detected several hundred moonquakes. Some are the result of meteorite impacts; others are caused by occasional landslides of the inner slopes of craters. But still other signals are true subterranean moonquakes. These true lunar quakes have magnitudes ranging only up to 2 on the Richter scale—a logarithmic scale for expressing the magnitude of a seismic disturbance in terms of the energy dissipated in it, with 1.5 the smallest tremor that can be felt. A tremor of such weak force is barely detectable by seismometers on the earth because of background static produced by human activities and natural noises.

Weak as they may be, true moonquakes nevertheless display a striking property: they occur most often when the moon's orbit most closely approaches the earth. At such times the earth's gravity exerts a forceful tidal pull on the moon that causes the rocks in its interior to slip against each other, producing jarring vibrations. This is evidence of at least a warm interior. But it should be noted that moonquakes are triggered by tidal forces, whereas earthquakes occur independently of tides.

The focus, or point of origin, of moonquakes is surprisingly deep. Most earthquakes occur within 100 kilometers (about 62 miles) of the surface, although a few extend to depths of 700 kilometers (about 425 miles). Lunar quakes, by contrast, originate in a zone 800 to 1,000 kilometers (500 to 620 miles) deep.

The fact that moonquakes occur at depths greater than 800 kilometers implies that the outer 800 kilometers of the moon constitute a thick shell of strong and rigid rock. If that is the case we can understand why the moon does not show signs of recent geologic activity on its surface. Its outer casing of rigid rock, or lithosphere, may be so thick that it cannot break up into a number of separate plates that move against each other as the earth's plates do, with associated earthquakes, volcanic eruptions, the upwelling of magma, and mountain building.

Beneath the thick, rigid outer lunar shell, there appears to be a layer of partly molten rock, analogous to the earth's low-velocity layer. Magma from this deep layer could reach the surface through the intervening 800-kilometer layer only infrequently and with great difficulty. We can therefore assume that ever since the thick, rigid casing was formed about three billion years ago, there has been little or no lava flooding on the moon's surface.

Deep moonquakes are not only much weaker than the average earthquake, they also occur far less frequently. The level of seismic activity on the moon in a year is less than one ten-billionth that of the earth. Seismically, the moon is an exceedingly quiet place. No other single Apollo finding has provided as direct an indication of the present state of geologic lifelessness of the moon.

The Apollo results as currently interpreted indicate that the moon's history is altogether different from the simplistic views of either the cold moon or hot moon schools of thought. Although the lunar surface is ancient by terrestrial standards, it is by no means the primordial, unmelted substance from which it accumulated. The evidence presented so far indicates that the moon was hot and geologically active during the first 1.5 billion years of its existence. It is not known whether the entire moon was then molten, but at least a layer 200 to 300 kilometers thick near the surface must have melted in order to produce the rocks found there. Gradually the surface layer cooled, but at the same time the interior warmed up because of heat released by radioactive decay. Rocks in the interior melted and were extruded onto the surface in a series of lava flows. This melting effect lasted until about 3.1 billion years ago. Then the moon's interior cooled, and except at very great depths it has remained rather cold and geologically inert ever since. In addition to the rock samples, further evidence that the moon experienced at least one major period of melting comes from the layers and chemical differentiation detected by the seismometer data.

Scientists won't complete their studies of the approximately 800 pounds of moon rocks the astronauts brought back for many months or years to come, but the Apollo missions have already shed much light on the moon's development and structure. Many mysteries remain, however. Chief among them is the question of how and where the moon was formed.

Theories abound, but at the present time there is no completely satisfactory explanation for the existence of the moon as our natural satellite. And since we are unlikely to return to that planet again within this generation, the explanation will probably have to be left to the astronomers and their telescopes. Meanwhile, we can ponder the wisdom of Harold Urey, who once said it is easier to pretend the moon is not in the sky than to explain how it came to be there. ☐

A Banquet for the Birds

by Richard M. DeGraaf and Jack Ward Thomas

Feeding wild birds is a popular national pastime with ecological implications for many species

The sight of bird feeders—hanging from tree limbs, on wooden and wrought-iron posts, atop all manner of fences, or nailed to porch railings—has become an integral part of today's suburban scene. It would seem that a large number of homeowners, who are not otherwise involved with conservation or wildlife, find it rewarding to have birds in the vicinity of their homes. This attraction may be attributed to a romanticized notion of the effect of trees, green lawns, and spacious backyards upon the esthetic sensibilities of former city dwellers, coupled with a desire to provide their offspring with the amenities of the countryside while also increasing their ecological awareness.

People living in cities also feed birds. Whether it is the proverbial old lady in the park feeding the pigeons or a housewife leaving stale bread crusts on the window ledge, feeding the urban bird population occupies a significant number of people. Bird feeding is also a favored pastime in rural areas: small-town residents and even farmers put out birdseed, suet, and other delicacies for the avian inhabitants of the countryside.

Whatever the locale, a lot of wild bird feeding is going on. Yet it is safe to assume that most of the people engaged in providing the handouts have no idea how their efforts affect the occurrence and numbers of local bird species by changing the ranges of certain birds and delaying migration. Because of the general dearth of urban wildlife research, the situation has not received much attention, but it should be investigated to determine the long-range portents for bird populations.

To grasp the potential ecological significance of wild bird feeding, we must first look at the amounts of food provided and monies expended. From our investigation of songbird habitat requirements, we learned that artificial feeding played a large role in supporting a number of songbird species in that environment. Under the auspices of the United States Forest Service, we conducted a random survey of households in Amherst, Massachusetts, to determine the extent of bird feeding in the area.

Of the 538 households queried, 43 percent indicated that they fed wild birds. Most did so in the winter months from December through March, but 58 percent of those feeding provided food through April, a crucial time because much of the natural food in the area has already been consumed, new crops, which produce seeds and grains, are not yet available, and there are few spring insects. Although most people

A gila woodpecker supplements its normal diet of insects and fruit with the seeds and bread crumbs provided by a suburban homeowner.

BRUCE COLEMAN, INC.

Seeds strewn on the snow are a food source that will help this flock of mourning doves and a blue jay withstand the rigors of winter.

MASSACHUSETTS AUDUBON SOCIETY

stopped feeding birds as summer approached, 16 percent continued to feed through July. This largess might be explained by the attachment many people expressed by referring to "my" mockingbird or "our" cardinal.

Several people reported maintaining ten or more feeding stations and spending in excess of $200, but the average bird-feeding household maintained 1.7 feeders and spent $8.80 annually on bird food. If 43 percent of the 5,250 households in Amherst similarly fed birds, they spent approximately $19,870 in 1972 on this activity.

Recent market research has revealed that 23.8 percent of the 861,024 households in metropolitan Boston fed birds in 1972, and that each household purchased an average of 69.6 pounds of birdseed during the year. Using then current prices, we can calculate that these 205,000 households spent approximately $8.20 each for a total annual expenditure of $1,680,000. These figures are even more impressive if extrapolated to the state of Massachusetts. Amherst, because of its suburban character, probably has a higher proportion of people feeding birds and Boston a lower proportion than the state as a whole. But, even using the Boston figure of 23.8 percent, of 1,762,140 Massachusetts households, about 419,000 engaged in this activity and spent $3,439,000 in 1972 for bird feed. These estimates do not include expenditures on feeders, binoculars, identification guides, or any other expenses associated with the enjoyment of songbirds.

Data from other metropolitan areas throw some light on the effects of city size on the residents' bird feeding activities.

Feeding wild birds is also popular in other countries. This blue tit alighted on a string of nuts hung by an English bird watcher.

J. MARKHAM–BRUCE COLEMAN, INC.

	Number of Households	Percent of Households that Feeds Birds	Average Annual Seed Purchase per Household (lbs.)
Milwaukee	442,804	19.4	64.5
Cleveland	659,487	24.7	57.6
St. Louis	750,164	19.8	64.5
New York	3,949,454	15.1	49.2

In the metropolitan area, the proportion of residents that feeds birds is at least statistically correlated with the population: as city size increases, fewer people feed birds. Not only that, but as city size increases, the amount of feed purchased per participating household decreases. These data may reflect proportional decreases in the amount of vegetation in the larger cities or at least of the type of habitat favored by some birds, particularly songbirds. Also people in the city may be less motivated to feed birds because they see fewer species; pigeons, starlings, and sparrows may be viewed as less attractive than cardinals and juncos. The social makeup of larger cities also creates life-styles that may not encompass the active enjoyment of wildlife. People who live in tall apartment buildings are less likely to feed birds; they are also less likely to see a variety of birds than people who live in garden apartments or brownstones with yards.

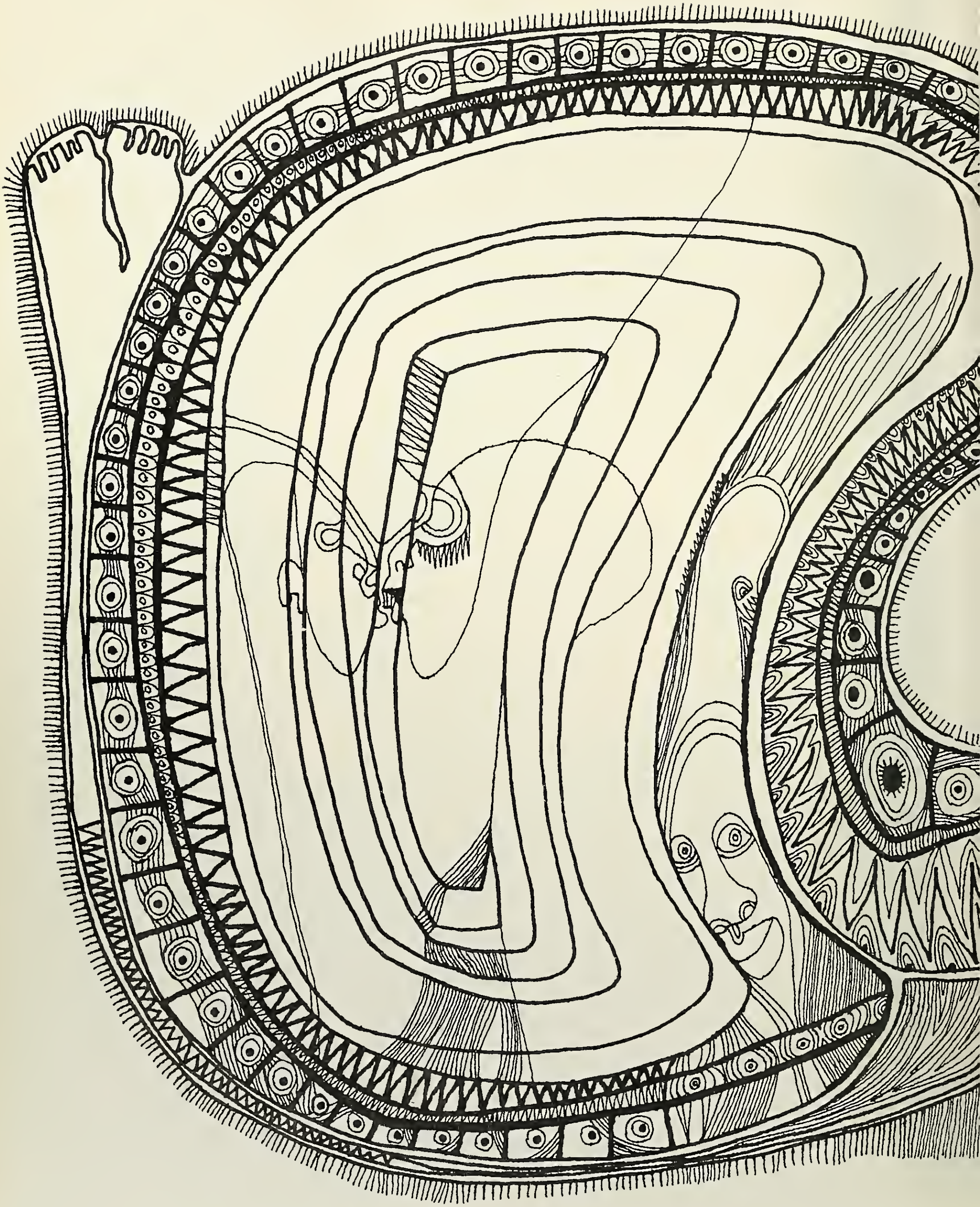
It is interesting to speculate on the effects of wild bird feeding on bird populations. In the northeast, as many as ten new species have appeared in recent years. Some species are undergoing range extension because of a great increase in the amount of edge habitat (where one habitat blends into another), the result of housing construction and the decline of agriculture. Winter feeding has a direct effect, allowing some southerly species, such as cardinals and mockingbirds, to survive the severe weather. Although we know that a general warming trend has been occurring in our hemisphere, it alone is probably not enough to explain the recent changes in bird distributions, both in terms of range extensions and numbers, that have occurred.

The evening grosbeak, originally a bird of western Canada, has spread eastward during the winter and now breeds in eastern Canada and northern New England. Flocks historically had wandered south in the winter on an erratic basis, but they now do so almost every year and this past winter were even found as far south as South Carolina. Although still unpredictable, their southward movements may be tied to scarcities of seeds and berries farther north. During their migration, they readily find sunflower seeds in suburban feeders.

Some biologists believe that winter feeding has increased the population of evening grosbeaks by reducing winter mortality. Many other usually migratory species are now wintering in the northern parts of their range, among them song, vesper, chipping, and white-crowned sparrows. The many tons of seed provided annually at feeders would seem to be at least partially responsible for this shift in bird distribution.

Those people who feed birds often make them an intimate part of their lives by placing feeders where the birds can be seen, watched carefully, and appreciated at leisure. Even the more common species appear more colorful and interesting when viewed close up. Knowing that these creatures are holding on and even increasing in spite of our seeming rush to suburbanize the earth can lift the spirit.

It often seems that the "American way" makes it necessary to put a monetary value on a resource before it is truly appreciated. Now that feeding wild birds has become the basis of an estimated fifty million dollar a year industry, perhaps more thought and effort will be expended on protecting wild birds and their habitat. ☐



The Starving Roots of Population Growth

by Roy E. Brown and Joe D. Wray

At the source of the world's increasing numbers are millions of malnourished children

Most people accept the concept that the population explosion is based on a decline in death rates, not on a rise in birthrates. The literature concerning developing countries is replete with arguments by economists, demographers, sociologists, politicians, and public health officials that, by substantially lowering death rates, public health techniques are responsible for the population crisis.

Although this remains a controversial issue, health professionals, who not long ago were placing increased emphasis on saving lives in areas infected with communicable diseases, now find that their budgets are being channeled into family planning programs. Alarmed by population increases, medical people are now becoming increasingly interested in the technology and mass distribution of contraceptive techniques.

This may not work. Family planning programs are only effective in conjunction with cultural, medical, and personal factors and, paradoxically, may fail totally in achieving zero population growth if adequate public health and nutrition are not available. Furthermore, it seems logical to assume that if modern medical technology is responsible for the population explosion, then the withdrawal of such services will reverse the trend, but just the opposite may be the case. Certainly, the assumptions need further examination.

Is there, in fact, a causal relationship between public health measures and population increases? The development of immunization techniques, antibiotics, and antituberculosis drugs, the eradication of malaria, and improved public sanitation have all been held responsible for declining death rates. There is, however, little evidence to support this; if anything, in many parts of the world such public health measures have made a negligible contribution.

In the late eighteenth century, for example, England and Wales experienced a decline in death rates and a corresponding population upsurge, a shift historians have attributed to medical improvements. True, there were larger hospitals, more clinics, and more health practitioners, but aside from vaccination against smallpox, the eighteenth-century physician had little technology to offer his patients.

Recently, a malaria eradication program in Ceylon was followed by a dramatic decline in the death rate and an increase in population. Yet falling death rates in Ceylon go back as far as 1905 and show an accelerated downward trend in the late 1940s, completely independent of malaria eradication programs. People who have studied this program conclude that, based on the available evidence, malaria control was not the sole major cause of a population explosion in Ceylon. The global effort against malaria began in the 1950s, after death rates began falling throughout the world; in fact as of 1967, only eleven countries had eradicated malaria.

What about antibiotics? Certainly, it is the popular opinion that the development of the so-called wonder drugs has played a crucial role in lowering mortality rates. Penicillin was first used in 1944 and broad-spectrum antibiotics became generally available after 1948; in the Western world, however, death rates had been falling since the 1850s, while from 1920 to 1949, death rates in eighteen developing countries fell about 35 percent, indicating no causal relationship between the development of antibiotics and lower mortality. Similarly, in the case of tuberculosis, mortality rates were declining sharply long before an effective antituberculosis agent was developed in 1945.

Furthermore, antibiotics are not widely used in the developing countries. Although available, they are greatly restricted in use owing to their cost, to lack of public knowledge, and to the shortage of health personnel and services. In contrast to the spread of technology and science in the West, the developing world has not yet felt the comprehensive impact of modern medical or health institutions. Yet mortality is declining.

As for improvements in sanitation, they have been found to affect both morbidity and mortality in early childhood. As of 1968, however, the World Health Organization concluded that "safe adequate water was not available to 90 percent of the population of the developing world," which strongly indicates that such improvements have not been important in the declining global death rates.

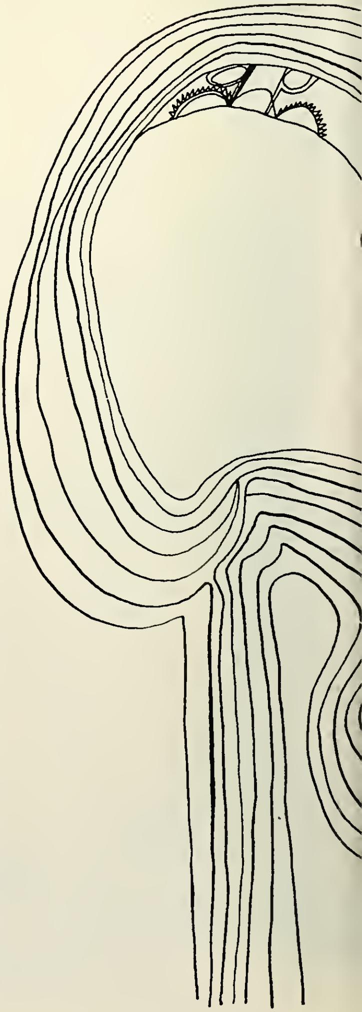
How is the decline to be explained? Probably the single most important factor is improvement in the standard of living, particularly raised nutritional levels. Over and over in a given population, we find that when death rates start to decline and the number of people increases, there has been a change in the quality and availability of food. It is important to remember that although a given country may be poor, with thousands of its children suffering from malnutrition, over all, the citizenry may still be better nourished than 50 or 100 years ago.

Conversely, in areas where childhood mortality rates are still high, malnutrition is widespread. Of the world's 60 million annual deaths, 30 million occur in children under the age of five years, and approximately one-half, or 15 million, of these deaths result from the combination of malnutrition and infection.

A study sponsored by the Pan American Health Organization showed that in thirteen cities and five rural areas in Latin America, malnutrition was an associated cause in from 30 to more than 60 percent of all deaths occurring in children under five years of age. When certain specific illnesses were considered, diarrheal disease and measles, for example, more than 70 percent of the deaths occurred in children who also were suffering from malnutrition.

Improving the general nutrition of a population has a much more marked influence on infant and young child mortality than does increasing the number of physicians or, by implication, improving the medical services. Dr. Harald Frederiksen studied data from twenty-one generally well-developed countries for the period from 1950 to 1960. Examining the relationship between changes in birth and death rates with other changes, he found a strong negative correlation between infant and early childhood mortality rates and increases in animal protein and caloric consumption and a weak negative correlation between these rates and an increased number of physicians.

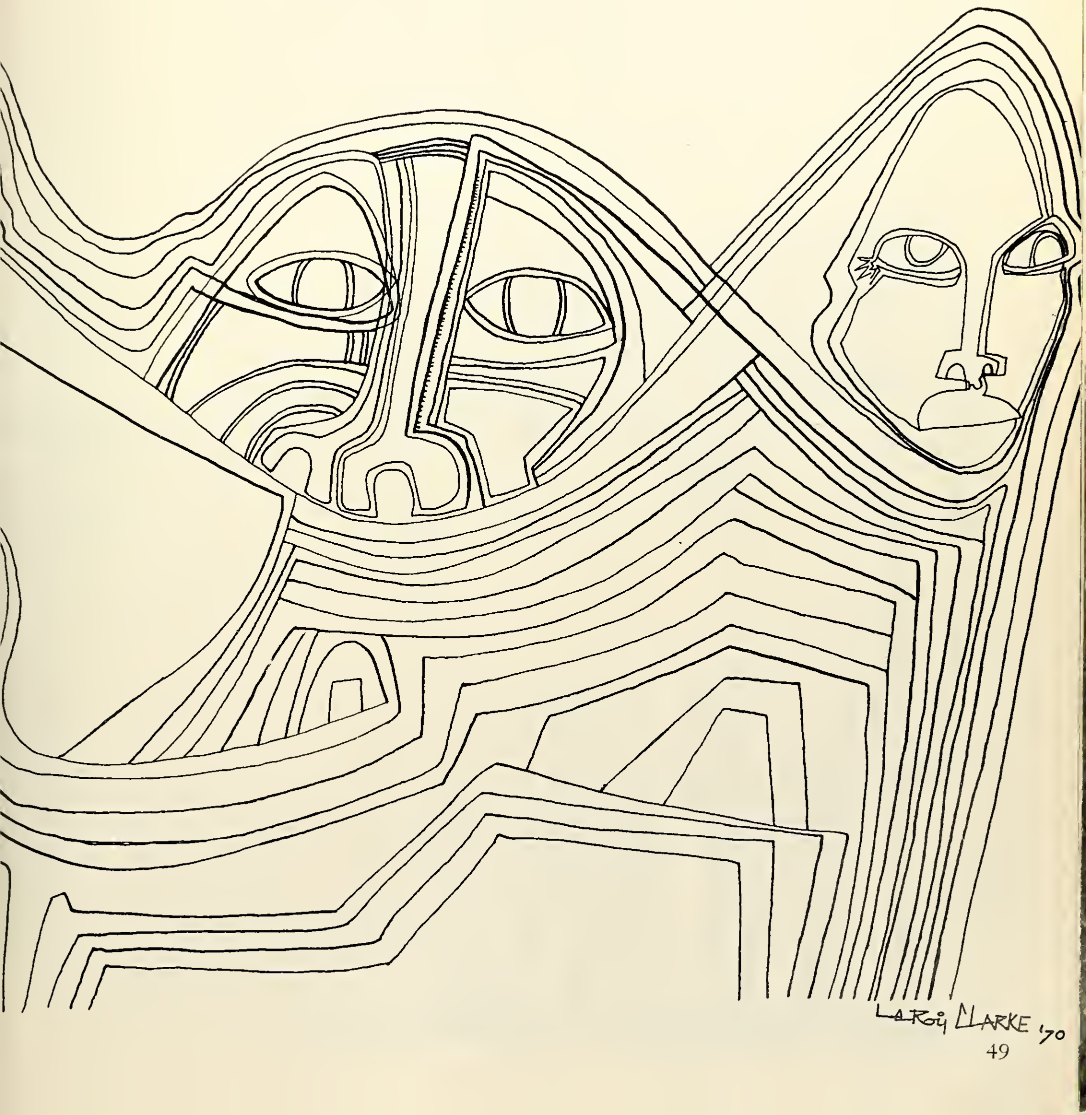
Additional evidence comes from the Cornell University health care project in the Many Farms Navaho Indian community. Despite carefully planned and executed efforts to improve medical care among the Navaho, there was little effect on infant mortality. The children were

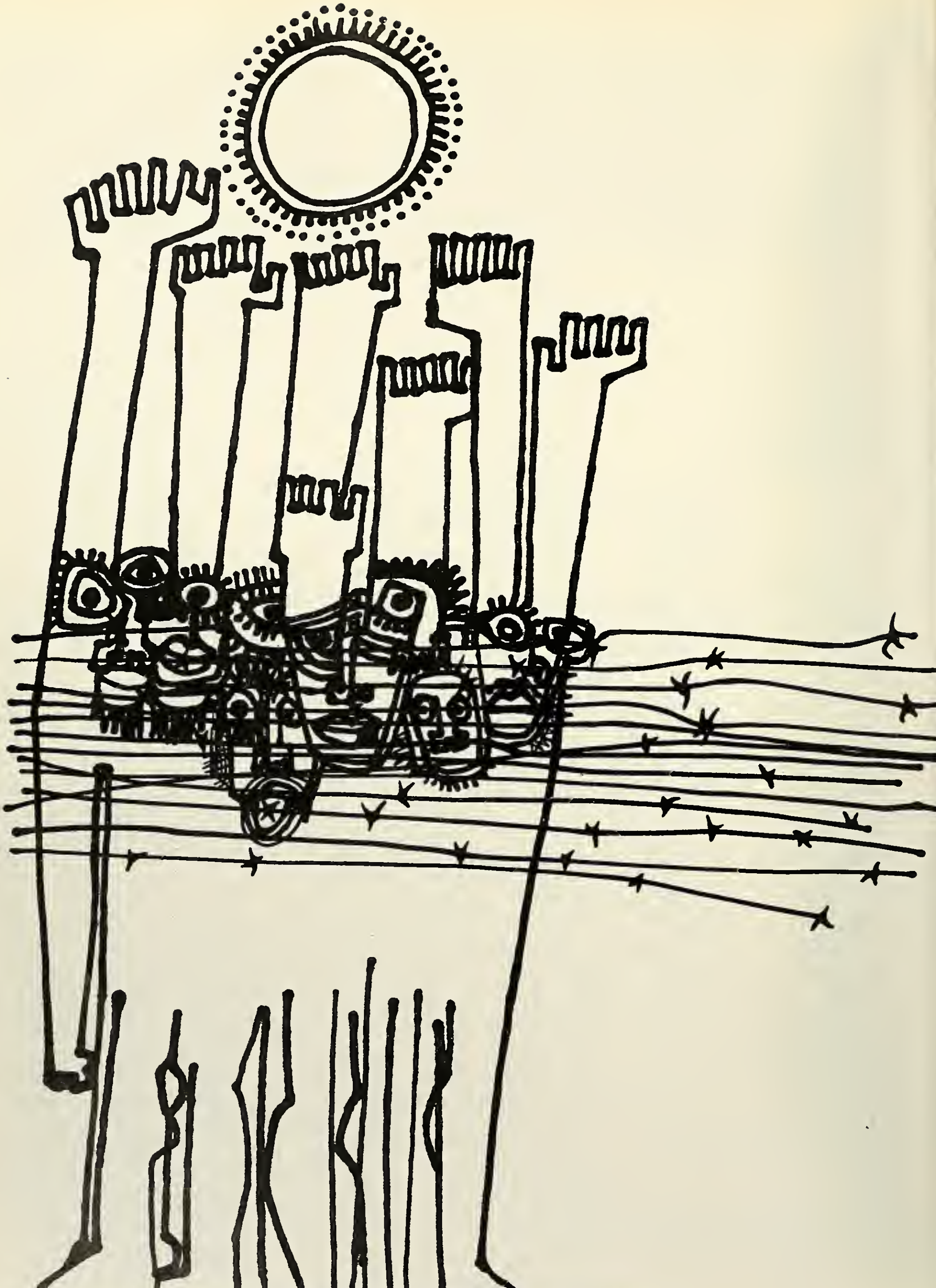


suffering from weanling diarrhea, which seriously interferes with nutritional status. If it were possible to eliminate such infections, the nutritional status of many children would improve.

Unfortunately, despite assumptions to the contrary, feasible medical methods for controlling infections in these children are not readily available at the village level. Summing up the situation at Many Farms, Walsh McDermott of the Cornell Medical School was explicit in his description of the situation: "The . . . well-named 'weanling diarrhea' . . . has a nutritional component, the precise role of which is unclear. It is definite, however, that while antimicrobial therapy may be helpful in some instances, it does not predictably and decisively alter the disease."

Finally, a five-year study of two Guatemalan villages showed that moderate improvement in the nutrition of preschool children produced improvements in morbidity and mortality equal to, or better than, those produced by an extensive and




LeRoy CLARKE 71

expensive medical care and public health program that did not alter the children's nutritional situation.

Improvements in nutrition can only be achieved in association with other changes. In Western countries, nutrition has been improving and death rates falling for the past two centuries; during this same period, we find the beginnings of stable government administration, reduction of destructive warfare, the improvement of internal security, the reduction of catastrophic famines, the encouragement of food production, and the expansion of road and railway development, which improved food availability. Simultaneously, irrigation programs were developed and communication and trade routes grew. As elementary education was expanded, literacy increased; not surprisingly, recent studies show that there is significantly less malnutrition among the children of literate mothers.

During the three decades from 1900 to 1930, infant mortality fell dramatically in New York City, from 140 per 1,000 live births to slightly more than 50. This was before there were any significant antibiotic drugs or specific vaccines for diphtheria, pertussis, and tetanus, among others. The period, however, was characterized by intensive economic and community development, social reform, and educational expansion.

Whether caused by political squabbles, lack of roads, or insufficient storage facilities, inadequate food distribution plays a significant role in malnutrition. With the construction of a new road, the redrawing of political boundaries, or a substantial increase in yearly crops, improved nutritional benefits may result.

The introduction of a new food source can be crucial, and historically, food changes have been associated with rapid population growth. Within 100 years after the introduction of the white potato in 1750, Ireland's population nearly tripled. The recent introduction of enriched flour in Scandinavia was followed by a decrease in childhood mortality, and the Chinese population explosion in the sixteenth century was related to the expanded use of corn, sweet potatoes, and peanuts.

But if improved nutrition means that more children will survive, won't increased population pressures ultimately lower nutritional status? On the contrary, as nutrition improves, infant and childhood mortality rates decline; as mortality rates decline, parents respond by having fewer children. Parents are not enthusiastic about family planning in the presence of high infant and childhood mortality rates. Family planning implies that planning will be successful, and parents should be able to plan that their existing children will survive to adulthood. Intrauterine devices cut down on births, but provide no insurance against dysentery, pneumonia, or malaria.

There is, in fact, evidence from Bangladesh showing a direct relationship between the death of a child and the probability of a birth in the family during the subsequent year. A study in an Egyptian community showed that a mother who has lost at least one child will desire a larger number of surviving children and will actually have more births than women in the same community who have lost no children. In the Philippines, too, a report shows that total fertility is lower in couples who have lost no children; it is also lower in communities where mortality rates are lower. According to Dr. Harold Taylor of The Population Council, "A basic dictum is that parents will not stop having children until they believe that those they already have are going to survive."

In developing regions, children are highly valued. Not only do they play an important economic role, helping with farming or other jobs, but by supporting their parents in their old age, children also represent a form of social security. Just as important, children are also desired for themselves.

The relationship between mortality and fertility has been called the "demographic transition." In the West, mortality rates began to slowly decline in the mid-nineteenth century; birthrates followed, also slowly. Over a period of many decades, these countries underwent a transition from high mortality and high fertility to low mortality and low fertility, with net population growth never becoming excessive. Today, however, mortality rates in the developing world have fallen rapidly and birthrates continue to remain at high levels. As a result, the demographic transition has not occurred and we have the population explosion.

It should be emphasized that fertility rates declined in the West long before contraceptive technology had approached the convenience or effectiveness demanded today, long before family planning services were readily available, when, in fact, publication of information about contraception could bring imprisonment. At a time when national population policies were unheard of and few were concerned with the long-term effects of population growth, birthrates were falling almost as rapidly as death rates.

This can only be interpreted as indicating that thousands upon thousands of families wanted fewer children and somehow managed to achieve their goal. Their decisions were so successful that the aggregate effect resulted in declines in fertility at national levels.

Given the available methods of limiting family size at the time, there must have been powerful and sustained motivating forces at work to produce such unprecedented declines in fertility in large population groups. Such motivation must have emerged from the everyday life situation, from the awareness of problems felt at the family level, such as "having another mouth to feed."

The same has been true in the developing countries; in many instances in which fertility followed mortality downward, there were no formal family planning programs. People were on their own, just as in the original demographic transition. In addition, the time lag is shorter, approaching several years.

When infant and child mortality

rates fell rapidly in Singapore after World War II, birthrates were not far behind. In rural Turkey, where infant and child mortality rates declined sharply when a comprehensive medical program, including family planning services, was established, fertility rates held steady for several years, then dropped, reducing the net population growth. Analyzing his data from Ceylon, Harald Frederiksen concluded that "[there is] such remarkable correlation between previous levels of the death rates and current levels of the birthrates, that low death rates merit consideration as contributing factors, if not prerequisites, for low birthrates in the less-developed, as well as the more developed, countries."

There is no question that increased family size is associated with increased incidence of illness, and thus mortality, which in turn keeps birthrates high. This has been documented among Indians in the Punjab, as well as among all social classes in the United Kingdom. As families get larger, there are greater economic limitations, more crowding, and poorer sanitary conditions. Children from larger families are also more likely to be malnourished than those from smaller families. In developing countries, as laboring men get older, their earnings rise very little, while family size may be increasing steadily. They attempt to compensate for this by spending a larger proportion of their income for food, but in fact, their per capita expenditures for food actually fall, and malnutrition in the children increases.

In addition to family size, child spacing plays a large role. Mortality, both among infants and mothers, is lower when the birth interval is longer. Repeated pregnancies followed by prolonged lactation produce sustained needs for high-quality protein in the maternal diet. Since these needs are poorly met in many parts of the developing world, we find the "maternal depletion syndrome," which contributes to low birthweight infants, poor performance in lactation, and often, early death among women.

Obviously, in the absence of effective family planning, the mother who has children at frequent intervals is likely to have more of them. The more young children in a household, the greater the demands upon the mother's energy and skills to provide adequate care for them. Dr. Benjamin Biel of International Planned Parenthood Federation describes "unconscious infanticide"—a mother attending less and less to each successive child and infant mortality rising with increasing birth order.

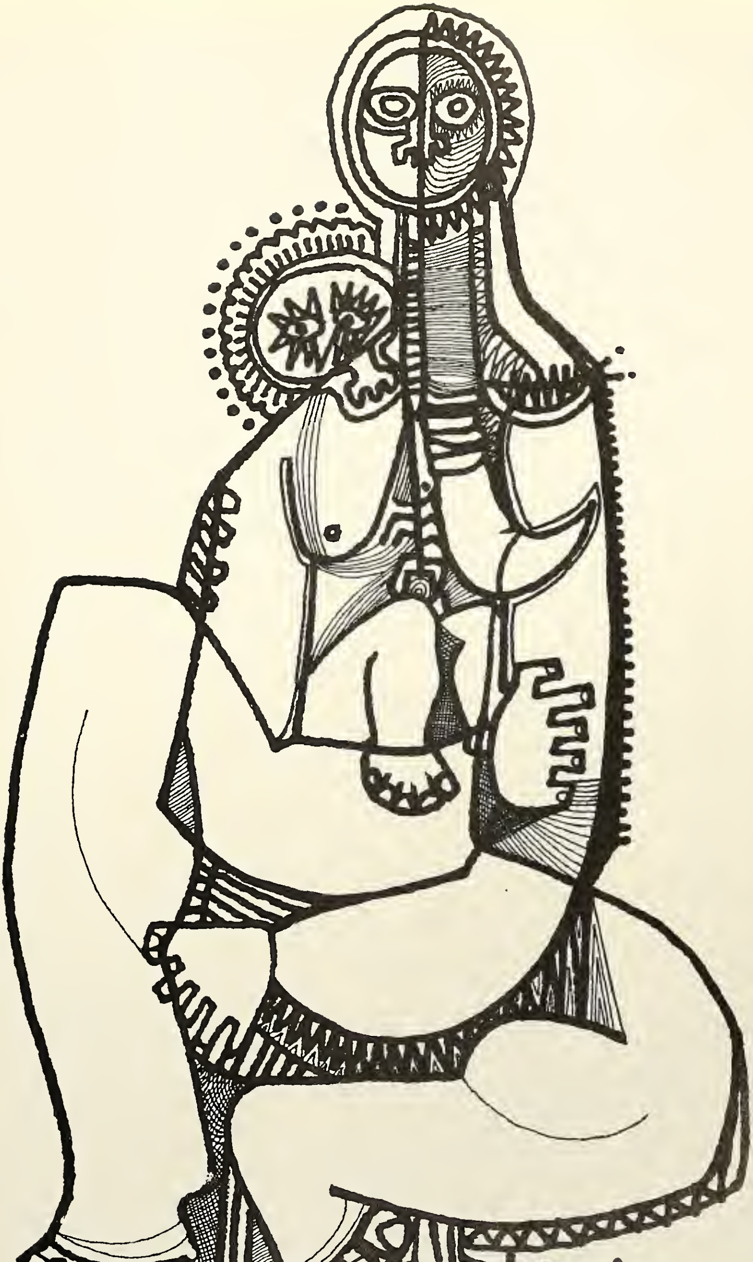
The continuing high burden of disease and death in some parts of the world is an effective obstacle to the rapid acceptance of family planning services. To expect people who are faced with high levels of morbidity and mortality in their own environment to rapidly accept family planning is to discount the reality of experience.

For these reasons, it is difficult to check birthrates until better child health care has been established. Economic development and the production and adequate distribution of more food will reduce mortality, even in the absence of any medical input whatsoever. Provided with a constant food supply, each individual will have more food available, thus increasing his chances of survival.

As long as demographers and economists seek to solve the population problem by emphasizing birth control exclusively, success in limiting population growth will prove elusive. Integrated programs of nutrition, sanitation, and public health services must be incorporated into a country's over-all program for family planning.

If we wish to limit population growth, the primary thing we must do is to lower infant and childhood mortality rates. When these remain at high levels, fertility will remain high, but when mortality rates decline visibly, fertility will fall within a few years. The most effective way to lower infant mortality rates is to improve nutritional levels. Therefore, the best birth control program is, simply, to feed the children. ☐

In a series of pen-and-ink drawings taken from his portfolio Fragments of a Spiritual, *Trinidad-born artist LeRoy Clarke evokes the struggles of people living amid crowding, hunger, disease, and death. Clarke is an artist-in-residence at the Studio Museum in Harlem, New York City.*


LeRoy '71

Trial by Fire

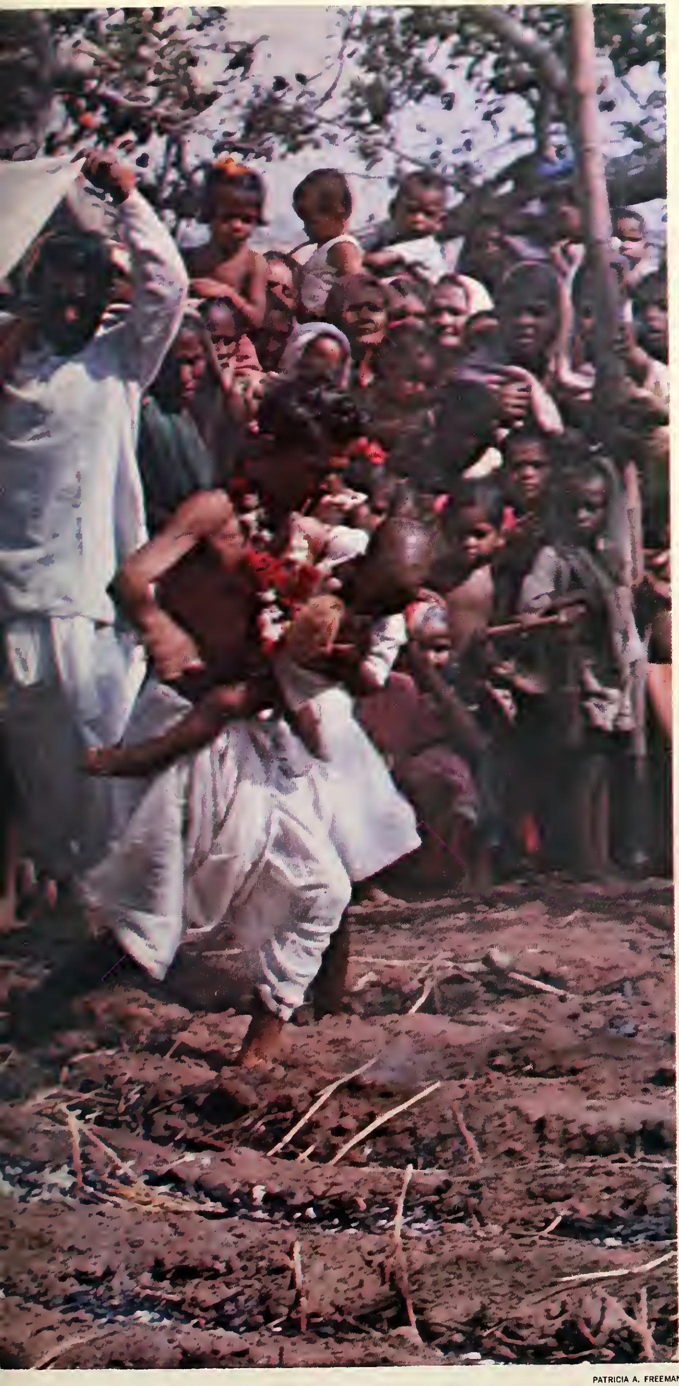
When their annual fire-walking ceremony failed, Indian villagers blamed the magician. But had their deities deserted them?

by James M. Freema

On April 15, 1972, a crowd of two thousand chanting spectators gathered around thirteen fire lanes of glowing coals in the village of Sunderpur, in the state of Orissa, India. Fifteen people, including two shamans and a chief fire walker, were led to the coals, where they walked and hopped the twenty-yard length in their bare feet.

The participants were well prepared for the ordeal. Most were not novices; indeed, some had done fire walking for ten years or more without mishap. Yet this year ten of the fifteen fire walkers were severely burned. After crossing the length of the coals only four times instead of the required seven, they were led away, hobbling and grimacing. One of them, breaking his vow of silence, murmured, "It was too hot, the fire has never been so hot."

In addition to suffering agonizing burns, the fire walkers were emotionally shaken. The villagers, too, were confused by the failure. The annual fire-walking ceremony is



Standing in pits of sacred water, fire walkers prepare to step onto the glowing coals. The participants contend that the muddy water does not protect their feet.

PATRICIA A. FREEMAN

Sunderpur's main religious event; a failure, which is rare, can cause great social distress.

Each year thousands of Orissans subject themselves to public ordeals by fire as a test of their religious faith in the power of the goddess Kali to protect them. The ceremony most frequently takes the form of fire walking, in which from one to twenty-five people walk or hop over a path of glowing embers while as many as twenty thousand spectators look on. There are, however, many lesser-known variations of the Kali ceremony. In some villages, fire swingers, blindfolded and dressed only in loincloths, are lifted up to scaffolds, trussed by the ankles, hung upside down, and swung through the flames in wide, sweeping arcs, while attendants throw pungent resin on the fire to make it flare up. The fire swingers, unharmed, are taken down after they have gone through the fire seven times in each direction.

In other villages, instead of ordeals by fire, the participants pass hooks through the skin on their backs or push hot skewers through their tongues. Elsewhere, the worship of Kali does not subject the participants to such dangerous practices; instead, the worshipers honor her by performing an ancient dance and devotional chant.

During the year, Kali worship is a routine part of everyday village life. But in mid-April, on a day known as Pana Sankranti or one day earlier, all secular activities are swept away in a surge of religious fervor climaxed by the fire-walking ceremony. In Orissan villages, the chief deity is the mother goddess, who has many forms and is known by dozens of names. The different forms have separate shrines in the same village. Worshipers pray daily, bringing offerings to the goddess they believe has helped them out of personal difficulties.

Kali is one of the most popular forms of the mother goddess, and Orissan folk artists frequently depict her ambivalent character in their paintings. Kali symbolizes the dynamic energy of the universe, embodying, at one and the same time, life and death, creation and destruction, which are seen as inseparable moments of the same dynamic process. As the active aspect of the Absolute, she is usually shown dancing on her husband, the deity Shiva, who represents the passive, eternal aspect of the Absolute. Both aspects are seen as inseparable, characterized in some paintings by the sexual union of the two figures. In some representations there are also contradictory symbols of life and death—a bowl of life-giving food, a freshly decapitated head, and a death-dealing sickle.

The themes of these paintings are ceremonially enacted on Pana Sankranti day. To symbolize death and devouring destruction, animals are sacrificed, and people representing Kali, the kalasis, drink the freshly spilled blood. To affirm life and celebrate the start of a new agricultural year, green mangoes are tied to the fire-swinging scaffold and libations of sacred sweet water are offered throughout the day.

Because they can go into trance, kalasis take a key part in the fire-walking ceremony. The villagers believe that as the kalasi is going into trance, his soul is expired in a convulsive breath, and the soul of the mother goddess enters with his next breath. This may occur during prayer, at a religious ceremony, or even on a secular occasion. During trance the kalasi, who can be either a man or a woman, is considered to be the deity and is addressed by the deity's name. In their everyday lives kalasis usually are not favored people, being either very poor or of very low caste. In their religious roles kalasis frequently have a large following of worshipers from all economic and social levels. The kalasi serves as the intermediary between the villagers and the goddess not only at the fire-walking ceremony, but also during the year, dispensing advice and performing cures.

The fire walkers are ordinary villagers who walk the fire by choice. They have asked the goddess to cure their own illnesses or those of close relatives, and in return, as a trial of their faith and ritual purity, they have pledged to perform some act involving the risk of physical harm. Parents of a sick child often pledge that the child will travel over the hot coals, walking alone if he is old enough or being carried by one of the participating adults if he is not. Many fire walkers pledge themselves not only for a single ceremony but for five or more years. Although all social levels—from Brahman at the top to Untouchable at the bottom—are represented among fire walkers, women are not permitted to walk over the coals unless they are kalasis.

The only preparations made for fire walking are spiritual ones. Seven to ten days before the ceremony, a villager who hopes to be chosen to walk the fire begins his ritual preparations of purification. He lives in seclusion in the village temple, prays, eats one meal a day of vegetables he has cooked himself, and maintains a vow of silence except among his fellow fire walkers and the kalasis. Usually there is a chief fire walker who teaches novices how to perform the purifying rituals that will enable them to step on the glowing coals without being burned. The candidates for fire walking are permitted to leave the temple compound only to visit the shrine of the kalasi, where they pray to be selected. On the night before the ceremony, the candidates fast and keep a vow of absolute silence.

Ordinarily, all costs of the ceremony are paid for by the participants. These expenses include the turmeric paste and oil they spread on themselves after morning and evening baths; the rice, lentils, and vegetables that make up their meals; new dhotis; the wood for the scaffolds from which they hang or the coals over which they walk; the fan that is used to keep the coals hot; the aromatic resin that is sprinkled on the burning coals; the dried coconuts they carry during fire walking as a sacred offering to the goddess; and their gifts to the

To test their faith, devotees in some Orissan villages are hung by their ankles from a scaffold, then swung through the flames.

JAMES M. FREEMAN

In a final act of devotion before crossing the coals, fire walkers roll through the village's dusty streets, straining to keep their chests off the ground.

JAMES M. FREEMAN

deity. For an ordinary farm laborer the cost is nearly a month's wages. To insure that no adult male will be denied the privilege of becoming a fire walker, public funds are used to help pay the expenses of those who are too poor to pay their own.

After they have been secluded in the village temple for seven days, the fire-walking candidates, in a final act of devotion to Kali, roll through the village streets. Then the kalasis, who have gone into trance, are led in a procession to the village temple, where they select those who are to walk over the coals. The fire walkers bathe and are further purified by contact with sacred objects, then put on new dhotis and smear their bodies—but not the soles of their feet—with turmeric.

During these ceremonies, attendants display sacred objects at each house in the village or at public shrines and prepare the sites for fire walking and other feats. After the selected participants have performed their feats, the attendants sacrifice animals. The kalasis drink the fresh blood, which is considered the food of the deity, then give advice and perform faith cures for their followers, finally going out of trance at the ceremony's end.

The physical ordeal ceremonies illuminate several important aspects of Indian village culture. First, these ceremonies share a common ritual symbolism with numerous other Hindu ceremonies. The symbols repeat, with endless variations, the opposing themes of purity and pollution, in which water and fire are seen as basic purifying substances, while the blood of sacrificed animals is associated with pollution and death. Those who slaughter the animals are the ritually impure Untouchables of the Washerman caste. Most Hindu ceremonies focus either on purity or pollution, that is, on "good," or auspicious, rituals that require the participant to acquire a high degree of ritual purity, or on "bad," or inauspicious, rituals that require an individual to eliminate pollution from himself. A Hindu's ordinary state is somewhere between these two extremes.

Fire-walking ceremonies are unusual because they incorporate both purity and pollution rituals in the same ceremony. Although many villagers cannot explain the symbolic significance of particular acts and objects used in the rituals, they are well aware of the basic symbols of purity and pollution.

In fire-swinging ceremonies, the fire is not an ordinary one; it has been sanctified by a Brahman who, in effect, creates a sacred altar and a sacred space within which the ritually purified participants perform their feats. He also utters incantations, inviting all the deities and sacred spirits to witness the event.

Within that sacred space, the scaffolds are constructed so that the fire swingers can be swung an auspicious seven times, first to the east and then back to the west. Auspicious rituals are begun facing the rising sun—the most sacred direction, associated with the absence of sin—and conclude facing the west. In contrast, inauspicious rituals are begun with the participants facing south, the least sacred direction, which is associated with sin, death, and the god of death.

The ceremonies are also closely associated with immediate, rather than long-term, religious needs. Many Indian villagers expect an immediate return for their prayers and sacrifices, and if they do not receive a satisfactory response, they may abandon the deity they were worshiping in favor of another. This is not mere caprice—it is seen as a necessity. Orissan villagers are hardworking, practical people, but they live in an environment of considerable uncertainty and scarcity. Natural disasters—cyclones, floods, droughts, and epidemics—hit on an average of six out of every ten years. Often arriving with surprising suddenness, these devastations are invariably beyond the control of the villagers, and they turn for help to their local mother goddesses. The fire walkers often make their vows during times of extreme personal hardship.

Nevertheless, Orissan fire walking cannot be explained simply as a reaction to hardship. Many fire

walkers have a commitment to their deity that runs far deeper than merely asking for help. In fact, many fire walkers explained to me that after completing their five-year fire-walking vows, they had decided to quit. But then the mother goddess came to them in a dream and reprimanded them; to please her, they returned to fire walking.

The ordeal ceremonies further reveal the pervasive importance of the caste hierarchy in the religious life of Orissans. The driving force of the fire-walking ceremony comes from the low-caste, shamanistic kalasis, who achieve religious status and power through their own efforts, and through whose bodies the deities are said to come into contact with ordinary people. The ceremonies they lead, however, are legitimized for the entire village by high-caste, hereditary Brahman priests who sanctify the fire according to the traditions that have been handed down through their caste group.

When the kalasis are in trance, their ordinary social position is forgotten, and worshipers of all castes pray before them, but when their powers fail, their followers desert them. Therefore, when the ten fire walkers, including one of the kalasis, at Sunderpur were burned in 1972, the villagers were bewildered, for their faith in the kalasis and in the power of the deity herself to protect them had been shaken.

In the ninety years since it was founded, the annual fire-walking ceremony had become Sunderpur's main religious event. In addition to those who walked over the coals, there were Brahman priests who sanctified the sacred fire used to light the coals, volunteers of many castes who prepared the beds of coals, men of the Washerman caste who slaughtered the animals offered in sacrifice, attendants from the Untouchable Bauri caste who carried the sacred objects of the deity, Bauri musicians and ritual dancers who accompanied the kalasis in their procession through the village, Untouchable Sweepers who beat the drums, and the chief fire walker, a man of the Cultivator caste who trained new volunteers and also walked over the coals every year, as his father and grandfather had done before him. His grandfather had founded the ceremony in Sunderpur.

For the past twenty years, the fire-walking ceremonies in the village had been conducted by the same kalasis, a man and a woman of the Untouchable Bauri caste. The woman, who was quite old, was the kalasi of the mother goddess Banadurga, while the man was the kalasi of the mother goddess Chandi. Both had walked over coals successfully for many years.

The fire walkers were confident that they would be successful. "As long as we follow the ritual observances," explained one who was completing his twentieth year of the ritual, "we can walk the fire without being burned."

The first indication of trouble occurred ten days before the ceremony, when the Chandi kalasi became involved in a quarrel with a man known as *gunia*, or "the magician." The villagers fear the magician because they believe he has malevolent powers. The magician, claiming that he was too busy to perform the ritual vows, boasted that he would walk over the coals without remaining and praying in the village temple for seven days. The Chandi kalasi, speaking in trance with the goddess's voice, threatened that the magician would be burned if he walked without preparing.

Despite the kalasi's warnings, the magician did not stay at the temple. On fire-walking day, just moments before the fire walkers were about to step on the coals, the Chandi kalasi astounded some two thousand spectators by tapping the magician with his cane, thus ordering him to walk over the burning coals. Later, the villagers said that the Chandi kalasi must have been challenging the magician's powers, expecting him to be the only one who would be burned.

The fire walkers, having already completed their ritual ablutions, waited nervously while the magician dipped his body briefly in the village pond, put on a new dhoti, and joined the other fire walkers. The chief fire walker, who had supervised the week-long ritual training of the fire walkers, appeared upset at the selection of the magician, and his attitude may well have caused his followers to panic. While the magician walked the twenty-yard length over the coals without being harmed, most of the fire walkers suffered severe burns.

The spectators should have realized that something was wrong when the fire walkers, carrying infants or offerings of coconuts, abruptly stopped after having run back and forth only four times instead of the required seven. But the crowd, excited by other events, paid no attention. Women were intent on gathering souvenirs of sacred hot coals, which they cooled in pits of sacred sweet water at the end of each fire lane, then tucked into their saris. The men and children were shoving to find a good place to witness the animal sacrifices, which were to be held in a small clearing between the village temple and the fire-walking area.

The villagers believe that on fire-walking day the goddess Kali must consume the blood of freshly sacrificed animals. Representing the goddess, the kalasis customarily drink the blood of decapitated goats from the shards of pots that have been broken to insure that they

cannot be used twice. They drink the blood of chickens directly from their severed necks. But no goats had been supplied, which added to the demoralization of the crowd and the humiliation of the kalasis. The Washermen refused to pour chicken blood into the broken pot that was reserved for goats. To save the ceremony, a prominent Brahman ordered the kalasis to fill the goat pot with chicken blood. While clearly upset by the break in tradition, the kalasis obeyed the Brahman's orders, but as they drank, the irritated spectators shouted to them to throw away the pots and drink directly from the severed necks of the chickens. "There's no need for those pots, the deity won't get enough blood that way and won't be satisfied." The kalasis pushed aside the pots and drank deeply from the severed necks of the fluttering chickens.

It was only at the conclusion of the sacrifices, when the fire walkers emerged from the temple where they had gone to offer their gifts to the deity, that the crowd realized the fire walkers had been burned. The kalasis stood near a tree ready to dispense favors, advice, and cures to their followers. When the fire walkers pointed at their feet, the Chandi kalasi told one of them, "Do you know why blisters are forming on your feet? Because your wife ate fish when she wasn't supposed to." To another he said, "You were burned because your wife arranged your ceremonial objects when she was impure." The chief fire walker replied by pointing at the Chandi kalasi's feet, which were also blistered. The spectators dispersed, bewildered and frightened.

It is not unknown for an occasional fire walker to be burned; when it happens, it is assumed that he has broken some ritual prohibition. But when two-thirds of the fire walkers, including a kalasi, were burned, the fire walkers were unwilling to place the blame on themselves.

On the following day village leaders and devotees assembled at the shrines of the kalasis and demanded an explanation for the debacle. Although both kalasis went into trance, neither gave satisfactory accounts. The Banadurga kalasi, a fragile, silvery haired old woman, was hard of hearing and probably never heard the question. The Chandi kalasi, except for uttering the characteristic high-pitched staccato shrieks he makes while in trance, also gave no reply. He simply rocked silently back and forth on his heels, and his exasperated followers accused him of being a fraud.

Again the chief fire walker demanded to know why he had been burned. This time the Chandi kalasi told him that he had broken a ritual prohibition, but because the magician had broken many rules and had been unharmed, the chief fire walker refused to accept this explanation. Grabbing a sacred cane of the goddess, he threatened to beat the Chandi kalasi and put an end to the ceremony that his grandfather had founded. The kalasi told the chief fire walker to beat the goddess and to stop the ceremony, for the goddess did not care what her followers did.

While the chief fire walker stood with the raised cane, the kalasi called the magician's son to him and told him that his father was responsible for what had happened. The magician's son called him a fake, grabbed two of the sacred canes, and struck the two kalasis several times. Then he turned to the stunned crowd and shouted that if these deities were genuine, they should strike him down at that moment. When nothing happened, he walked triumphantly away.

The followers of the kalasis were furious, not only at the youth but also at the kalasis for allowing themselves to be humiliated. When the Chandi kalasi came out of trance and fell into the arms of one of his devotees, his followers admonished him never to become a kalasi again. But the angry devotees of the Banadurga kalasi refused to help her come out of trance. They simply told her to go home, then threatened to dig up the shrines and smash the images of the deities.

The disgruntled followers waited three days for the magician's son to be punished by the deity. When he went unharmed, they held a trial, presided over by leaders from the surrounding villages. As everyone expected, the magician and his son were found guilty and fined a substantial sum to deter them from disrupting future ceremonies. A few judges believed that there was no way to prove whether the magician had used magic to disrupt the ceremony. Furthermore, they believed that levying a fine would not prevent him from using magic in the future. But they agreed to fine him in order to deter his son from assaulting people and desecrating sacred shrines.

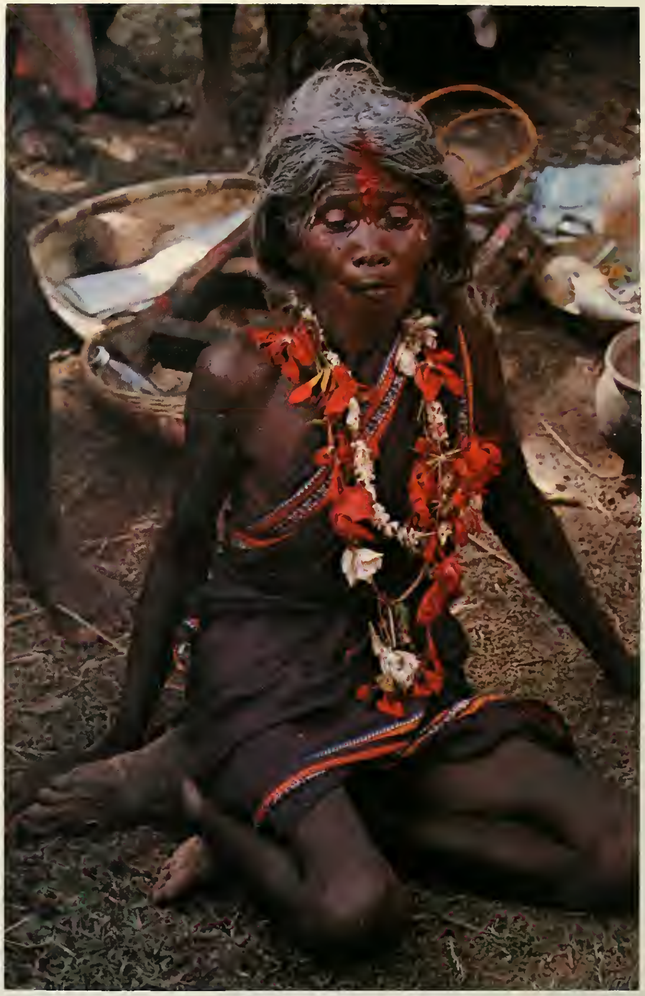
Although most villagers considered the decision a fair one, they knew that the crucial issue remained unsettled. How could the deities and their kalasis be depended on to protect their followers when they were unable to protect themselves? Despite his having been fined, the magician was clearly the victor in this round of his power struggle with the Chandi kalasi. How could Sunderpur's fire-walking ceremony continue in light of the deity's humiliation and the loss of her followers' faith? There were, of course, other goddesses and kalasis to whom the villagers could turn, but they were reluctant to abandon the Chandi and Banadurga kalasis on whom they had depended for most of their lives. They waited uneasily to see if the kalasis could vindicate themselves.

The Chandi kalasi appeared no more certain of the future of the ceremony than his followers. Like his devotees, he threatened to beat the deity for what she had done to him. He told me that he disliked the goddess because she never helped him. She only helped others, he said, while he remained poor and ill. When I left India three months later, the Chandi kalasi was still waiting for some sign that he and

Although he defied the kalasi and did not follow the prescribed rituals, the magician walked the coals without mishap.

PATRICIA A. FREEMAN

Followers believe that a kalasi in trance, right, represents the mother goddess. Because the deity must consume fresh blood on fire-walking day, the kalasi, far right, drinks from a decapitated chicken.



JAMES M. FREEMAN

his goddess had been vindicated.

What caused the fire walkers' failure? I believe that, subjected to two severe psychological shocks just as they were keyed up to begin their ordeal, they totally lost self-control. The delayed start of the fire-walking ceremony and the selection of the magician, despite his lack of ritual preparation, jolted them. Once the failure occurred, however, the burned fire walkers refused to accept the responsibility for what had happened. Instead, they blamed the kalasis for failing to protect them and the magician for disrupting their ceremony.

It is not surprising that the villagers concurred with the Chandi kalasi in accusing the magician. Villagers look upon magicians with fear and loathing, for they believe that magicians deliberately cause evil spirits to enter the bodies of young women, making them hysterical. Magicians, however, are needed to cure the very victims they are believed to afflict. Therefore, although he is distrusted, the magician must be placated. A powerful magician thus controls his neighbors through fear; at the same time he earns substantial fees for curing them.

Occasionally, magicians are said to be so powerful they can cause a local deity to come under their control, after which the deity's powers are used solely for the magician's malevolent purposes. The villagers of Sunderpur believed that their magician was attempting to gain control over their local deities. Understandably, the two kalasis felt threatened, as did the chief fire walker, for their prestige rested on their success in the fire-walking ceremony. Other villagers were shaken because the deities in whom they believed and on whom they were dependent were about to be taken from them. In ordinary circumstances, the villagers, fearing drastic retaliation, would not oppose the magician. But the threatened loss of their deities was more then they could tolerate, and they acted quickly to prevent it.

The failure of the ceremony also highlights the lonely, unpredictable life of an Indian kalasi. Unlike a Brahman priest, the kalasi does not inherit his religious position; he acquires it through his own abilities and he loses it through his own failures. If he fails to cure the ill, he is insulted and sometimes beaten by his irate followers, who may desecrate his shrine or smash the image of his goddess.

In view of the harsh conditions and uncertainties the Orissan villagers face daily, it is entirely understandable that they may abandon a goddess for one who is more powerful and can meet their immediate needs more successfully. □

Tents and Tactics of Caterpillars

A colony of western tent caterpillars has leaders and followers, a snug home, and a bag of survival tricks

Text and photographs by William G. Wellington

The sudden change in behavior of the hundred caterpillars was as unexpected as it was dramatic. Within seconds, the placidly browsing colony of western tent caterpillars stopped eating the leaves of a red alder tree, turned almost in unison, and rushed back to their tent at the base of the branch. In less than a minute, the members of the colony had disappeared inside the silken shelter. We were left standing beside the tree, wondering what had caused the miniature stampede.

And truly it had been a stampede, compared with the sedate, nose-to-tail processions that had become so familiar during the weeks we had been recording the behavioral patterns of this colony. Tent caterpillars that have finished eating normally return to their tent at a leisurely pace. Once there, they mill about on its surface for a few moments before settling in a closely packed cluster to bask and digest their meal. So the suddenly interrupted feeding, the headlong rush, and the dramatic disappearance caught our attention.

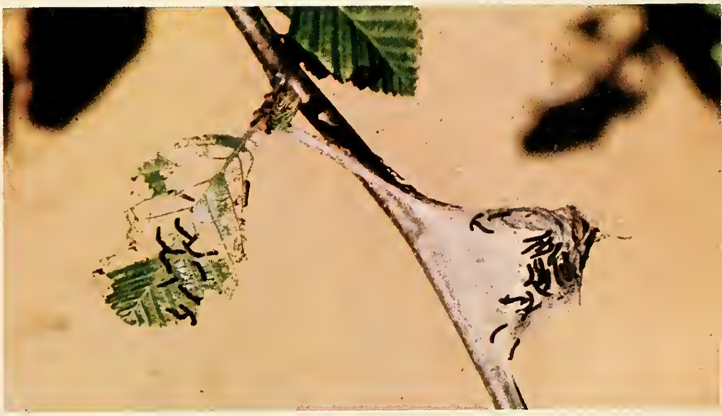
We had been watching this colony since the eggs hatched in early April because we wanted to know if weather changes might affect caterpillar behavior and development—perhaps even survival. We had decked the leaves, the twigs, and the tent itself with a tangle of sensors, which continuously reported temperatures and moisture levels where the insects lived. The colony was in an exposed location, so our first reaction to the unusual behavior was to look at the microclimatic recorder.

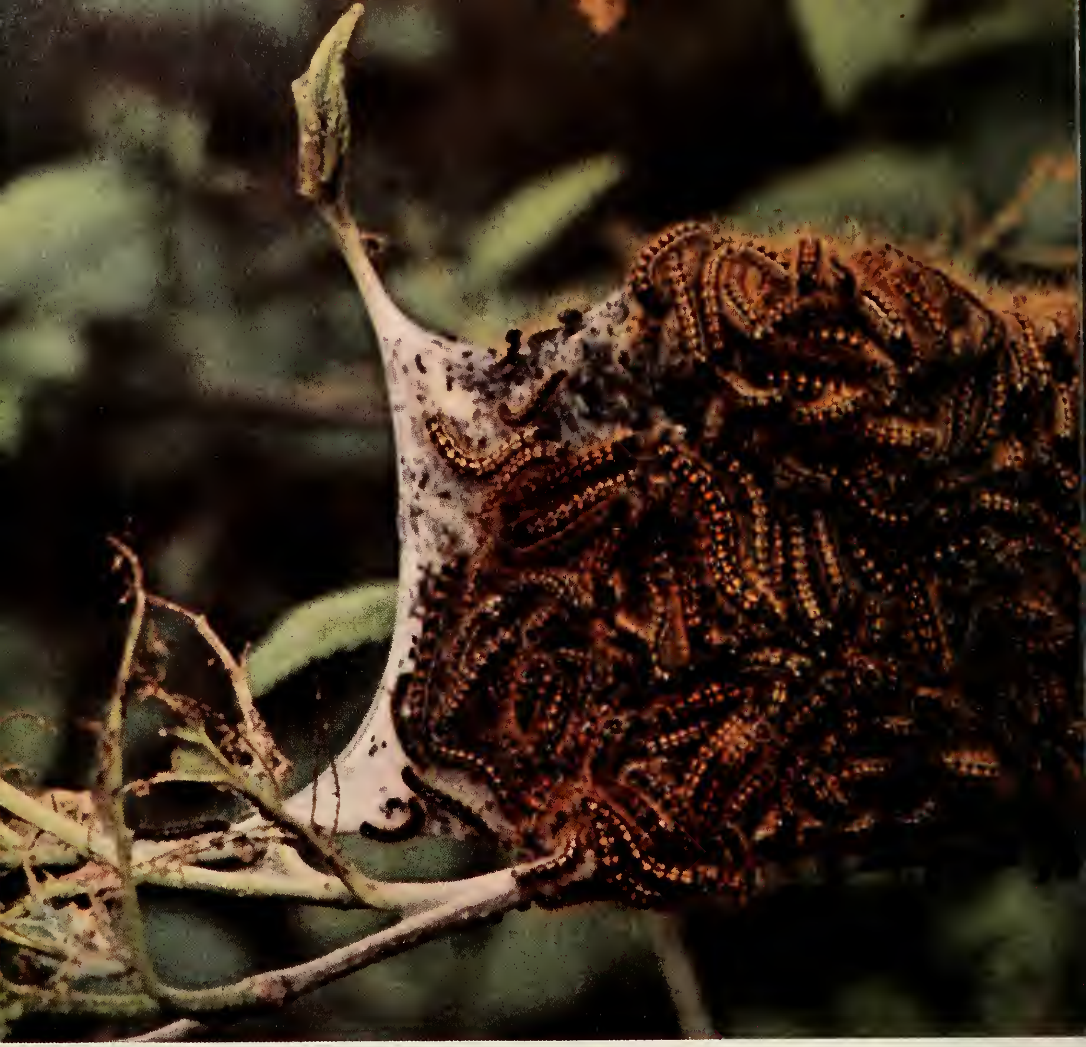
The sensors, much more responsive than ordinary thermometers, register minute changes almost immediately. Their recent traces, however, showed no unusual feature nor did they deviate as we watched them for a few moments longer. We were ready to conclude that, despite the insects' uncommon behavior, nothing extraordinary had been happening to the microclimate in which they lived. Some of us were even beginning to suspect that we had read too much into that behavior, when my assistant pointed to the recorder. All the traces for surface temperature—leaves, bark, and silk—had suddenly begun to drop sharply! A moment later, the air temperature also began to fall, and in less than half an hour there was no doubt that a cold front was overhead.

While rain and wind lashed the area, the caterpillars remained snugly in their tent, impervious to raindrops and wind. They did not reappear until intermittent sunshine again warmed their tent. But we continued to wonder what early warning system had induced the group response so far in advance of the changes our meteorological sensors measured.

Temperature measurements had already shown that the tent often became a sort of a greenhouse, collecting heat in sunny periods and slowing its loss during cloudy intervals. It provided a warmer and

Shortly after hatching, left, a whole colony of quarter-inch-long western tent caterpillars feeds on a single leaf of a red alder tree. Their silk shelter has begun to form. At first, the larvae feed mainly on the epidermal layer, but two days later, right, they have begun to turn the leaves into skeletons. The long shape of the tent indicates this is an active colony, which probably will build several tents in its lifetime.



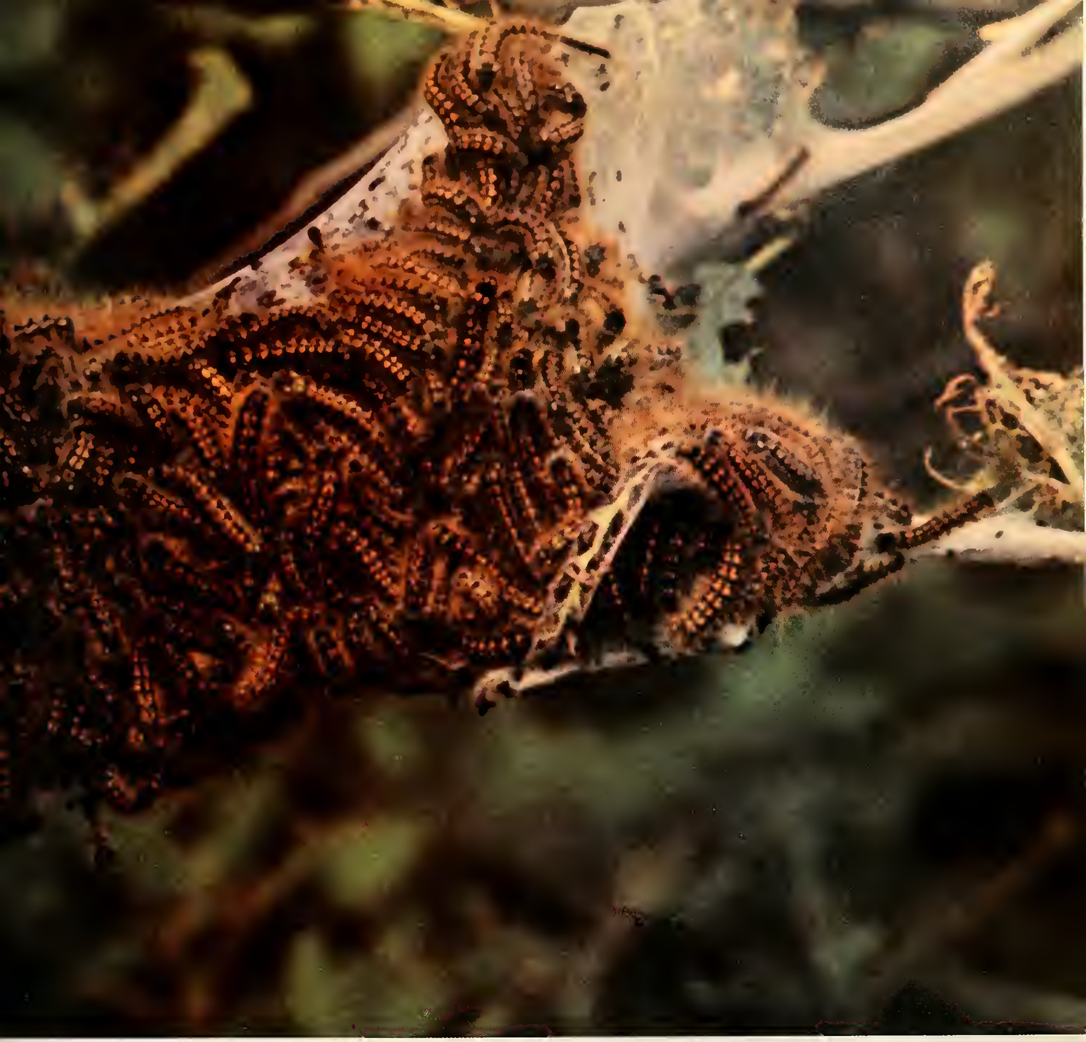


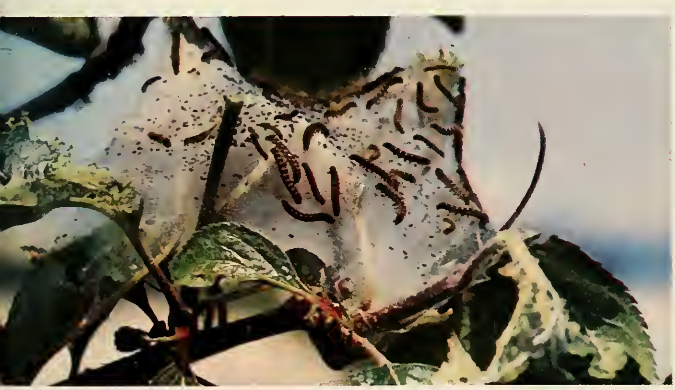
more even environment than the uncertain spring weather outside its walls. So there was no doubt as to why the caterpillars had sought their shelter. The question we could not answer was: how had they detected the impending change?

The silken shelter the colony sought is a remarkably versatile support system if one must live on a tree branch in coastal British Columbia in April. Although spring weather everywhere is variable, there is ample support for the belief of Canada's West Coast residents that their springs are, in the best Orwellian tradition, more variable than others! So the western tent caterpillar needs every adaptational aid it can cull from its evolutionary storehouse to survive in such a hostile environment.

At first glance, the very young larvae seem poorly suited to their harsh surroundings. To move about to seek food, they must have an ambient temperature above 60° F. But the spring air is often below 60° F. Also, the larvae soon perish in very moist or very dry air, and according to local residents, there are only two kinds of Aprils on the West Coast: too dry or too wet.

The conflict between the tent caterpillar's delicate constitution and the harsh weather ordinarily would guarantee extinction, but the silk tent is a remarkably effective shelter against climatic extremes. When the outside air is too dry, the silk walls act as a vapor barrier, slowing the passage of moisture outward and thus reducing the risk of desiccation. When there is rain, the impervious walls shed water and prevent flooding within the shelter. But the tent's prime advantage is the "greenhouse" function. Because the shelter collects and retains heat, the tiny larvae can continue to feed on enclosed leaves





Tent caterpillars of an active colony, above, bask on their elongated tent while digesting their meal. When active individuals at the edge of the group stir, the members will disperse and resume feeding. Active caterpillars may feed as far as 20 feet from their tent. An inactive colony, left, has a compact tent. Because these larvae feed less frequently, the colony develops more slowly than an active one.

when passing clouds interrupt the sun's warmth. In years when sunny weather predominates, the young larval develop unhindered, larvae survival is high, and the number of caterpillars is likely to increase. In contrast, cloudy springs with prolonged wet periods are harmful and many colonies are decimated.

As the larvae grow, they spend more time traveling out from the tent to eat. They usually have several feeding periods each day, interspersed with rest periods during which the caterpillars return to cluster on the tent's surface.

Once again, silk sheets have an advantage. Although cold-blooded animals can make brief forays into cool, leafy shade to obtain food, they have difficulty digesting their food in cool places. Because metabolic processes accelerate at higher temperatures, digesting a meal while basking on the warm tent surface is a quick method of transforming lunch into body growth.

Curiously, the tent, which contributes so much to growth and survival, is in one sense a mere byproduct of that basking habit. The young caterpillars continously trail silk from their mouths as they move about the tree. On the branches, the silk threads form highways that lead to different feeding places. At the basking site, a pad of silk is produced during the restless milling that precedes and follows basking. That pad forms the foundation of the tent. The milling accompanying each subsequent rest period adds successive layers, so the tent grows in size and complexity day by day.

As the tent extends over nearby twigs, its layers begin to form a series of interconnected compartments. Within those compartments, a change in behavior takes place after the caterpillars complete their third molt, usually in the fourth week after they hatch.

Migrating tent caterpillars tend to climb up and travel along train rails, impeding the progress of engines on upgrade slopes.

Every insect, at certain stages in its life, displays innate responses to unfavorable circumstances, which help it survive the stresses of potentially lethal extremes. To humans an insect's responses may seem a bit roundabout, but from the insect's point of view they generally work very well. For example, defoliators that feed on sunlit leaves may be exposed to dangerous solar heating. As it becomes hot, the insect may not be able to locate a temperature gradient that it could follow to a cooler place on the leaf. While a route of lower temperatures may not be apparent to the insect, there is nearly always a gradient in light intensity that can serve equally well. So an overheated insect can reach a cooler place by moving quickly to the darkest spot it perceives. It returns to a brighter area when it gets cooler.

That is how the young larvae of the western tent caterpillar behave. When they are too hot, they move to the shade; when they are cool they move into the light. When they are small, such changes may involve nothing more than crawling from the top to the bottom of a leaf. As they grow larger, they may have to move along a branch.

Until they pass their third molt, the caterpillars respond negatively to light when overheated. After that molt, an overheated caterpillar responds positively to light and moves to the brightest spot. When it reaches the brightest place, it lifts the forepart of its body until its head is pointed directly at the sun, and maintains that posture until ambient temperatures fall below the level that produced the response.

This reversal in behavior coincides with a seasonal increase in solar heating that can raise the temperature drastically inside the tent. During the hotter days in May, the older larvae customarily spend the midday period inside the tent, moving from compartment to compartment as each chamber overheats. While the sun is highest and most intense, they are not exposed to the dry heat outside.

The last compartment often does not become too hot until after midday. By then, although the air temperature may still be rising, the sun's heat has already begun to decrease. Consequently, when the caterpillars finally respond to overheating by emerging from the tent into the brighter light, the conditions they encounter outside have already improved. They further reduce the heat load on their bodies by their stance, which exposes the least amount of body surface to the sun's rays.

The changed response to light thus enables the western tent caterpillar to take advantage of the tent, despite the disadvantage arising from the more intense solar heating that occurs later in the season. Interestingly, another, unrelated tent dweller, the fall webworm, also displays this change in response among its older larvae, whereas the closely related forest tent caterpillar, which does not construct a tent, does not change with age. Both young and old larvae of the forest tent caterpillar respond to overheating by moving into the shade.

Another kind of response to light becomes important when the maturing western tent caterpillars leave the colony and scatter to feed as isolated individuals. About two days before they are ready to spin cocoons, these isolated larvae drastically change their behavior. For the first time since hatching, they stop eating and become extremely restless, crawling long distances over the ground in what is called "prepupational travel." (That is the state in which they may be found crossing roads or climbing the walls of houses.)

Like the honeybees studied first by Karl von Frisch, the traveling caterpillars navigate by referring to the pattern of plane-polarized light from the sky overhead. Their dependence on polarized light can be demonstrated easily. If you cover them with a polarizer and rotate the polarizer, the larvae will correct their direction of travel accordingly.

Every species of tent caterpillar exhibits this response. Its rigid dependence on the sky's light pattern has led to the forest tent caterpillar's colorful reputation as a train stopper. Whenever large infestations occur in aspen forests, mil-

lions of caterpillars may descend from the trees in a few days and begin their prepupational travel. If the caterpillars reach a railroad track, they climb onto the steel rails, but rarely climb down again. Thus the growing throng atop the rail is channeled along the track. A train encountering the horde on even the slightest grade cannot maintain traction on the slippery rails.

Train crews have mounted brushes and sanders ahead of the engine with no success. Railroads might better prevent the caterpillars from reaching the rails by exploiting their known behavior. On slopes, a dummy rail on either side of the tracks would collect and retain all the inept climbers, thus preventing them from reaching the functional rails.

With a range of marvelous strategies involving behavioral changes in response to heat and light, families of western tent caterpillars survive the fluctuating, often harsh weather of West Coast Canada. But an even more fascinating type of individual behavior is vital for the survival of the species. Each caterpillar, when it is born, tends to fall into a behavioral spectrum consisting mainly of two classes of larvae: dependent and independent. The differences between these two classes become apparent from the first day that the eggs hatch into a squirming, greenish brown mass of tiny larvae.

Many of the tiny caterpillars cannot leave their hatching place without a silk trail to guide them. But some do not need an existing trail. They can create one, and in doing

An active caterpillar colony emerges from its heated tent. At this stage, the larvae cool themselves by pointing their heads at the sun.

so they lead the rest of the family away from the egg cluster.

The proportions of dependent and independent larvae vary among families. Some families have only a very few active, independent members and a much larger number of comparatively inactive, dependent ones. In the latter, several of the inactive larvae may be so sluggish that they seem almost comatose. In contrast, other families have as many as 40 independent individuals out of some 200 members. Such groups have few exceptionally sluggish larvae; often they have none.

These individual differences persist throughout the life cycle. Highly active larvae ultimately become active moths that can fly for miles before they tire. Less active caterpillars transform into moths with reduced flight capacities. And the most sluggish individuals, if they survive to the adult stage, become moths that can scarcely fly.

Because the differences in activity and behavior are persistent, they influence every facet of tent caterpillar existence. The proportions of the different kinds of individuals within a family crucially affect the development of the colony that arises from that family. The wrong proportions—too few active and too many extremely sluggish individuals—mean certain death for all members, active and inactive alike, even in the best environment. Group activity in such colonies is simply too low to foster individual survival.

A small increase in the proportion of active members will produce a somewhat inactive colony that may survive a favorable spring, but not an inclement one. In good years, therefore, such colonies increase in some localities; in bad years, they decrease everywhere.

On the other hand, if 20 percent or more of the hatchlings are independent individuals, a colony will be sufficiently active to withstand all but the harshest springtime. In favorable weather it thrives. In bad years it may be the only kind that survives.

The proportions of the different types of larvae influence colony development mainly through their effect on the length of the clustering periods between meals. A cluster forms because a few caterpillars stop milling and stay perfectly still. The tufts of bristles protruding from their sides catch those of their neighbors, thus halting them. So the restless throng soon becomes a motionless cluster.

The cluster disbands because some individuals in the outermost ring of larvae become sensitive to the drying of their exposed flanks as they finish digesting and become hungry again. Their squirming is transmitted like a wave through the whole cluster via the interlocked bristles, and in a few seconds, the group disbands.

The activity rating of the larvae that start the clustering process is unimportant. Any motionless individual can be an anchor point. But the activity level of those on the perimeter crucially affects the duration of clustering. If those larvae are very active types, they quickly become restless as their hunger increases and their exposed sides dry, so clusters to which they belong break up according to their faster digestive rate, not the slower rates of less active members. In contrast, if the perimeter includes only less sensitive, sluggish individuals, the duration of clustering is greatly prolonged. Only near starvation is likely to rouse the worst sluggards and then, only briefly.

In a colony with many more sluggish than active members, the odds are against active individuals often being on the edge of the cluster. The sluggish colony therefore spends much more time clustering than feeding, so the growth of its members soon begins to lag behind the growth of members of an active colony. On the perimeter of a predominantly active colony there are always some agile larvae that can quickly break up the cluster; therefore, the members of an active colony eat often and develop rapidly.

In both types of colonies, active individuals trapped in the midst of a cluster cannot rouse themselves or their fellows. Their interlocked bristles and the proximity of other comatose forms seem to immobilize them, regardless of their hunger. Possibly the higher level of respired carbon dioxide within the cluster is also a factor; the gas quickly stupefies most insects.

The different types of colonies produce different tents. The larvae of active colonies move restlessly up and down a tree branch before they cluster, so their tents become long and narrow. Less active colonies mill about in a more confined space, so their tents are compact; often, they are nearly square or pyramidal.

Very active colonies build and abandon several tents in rapid succession, while inactive colonies enlarge the original one. Infectious disease is slight among active colonies because contaminated tents and diseased cadavers are abandoned quickly. Inactive colonies are more likely to become diseased because the living continually encounter the dead.

Since an active colony moves its tent site from branch to branch, its members constantly have access to fresh, undamaged leaves. The inactive colony is soon eating already damaged foliage, so its food is less nutritious. The larvae of the most sluggish colonies never venture more than a few inches from their tent, even after destroying every leaf in the vicinity, and may starve only inches away from foliage just beyond their limited reach.

The level of colony activity influences the fate of each individual caterpillar. Each individual's level of activity depends, in turn, initially on the order in which it developed within its mother's ovaries. The first eggs obtain more of the maternal food reserves than the last, so the first few embryos are the most vigorous. When an egg mass hatches, the most active larvae emerge from the first-laid eggs; less active individuals emerge from eggs deposited later; and the most sluggish, the moribund, and those too weak to pierce their own eggshells are found among the last eggs deposited.

The gradient in vigor and activity that the female imposes on her progeny is not affected by her own activity rating. Active and inactive females alike produce their best eggs first and the worst last. But if the range of vigor they impose is constant, the proportions of the different kinds of progeny they produce are not. An active female, which has fed well as a larva, enters her pupal stage with much greater food reserves than her inactive sisters. Thus she can produce a greater number of active progeny before she begins to produce less active ones. And differences in the proportions of the various types of progeny are, as we have seen, the basis for the different kinds of colonies.

As female vigor is also expressed in flight, the moths that produce the most active colonies also are the ones that fly farthest to deliver them. Less vigorous moths lay their eggs closer to their own birthplace. Thus the differences in activity govern the placement of each new generation, as well as its growth and survival.

Spreading the risk by keeping some progeny near the parents' birthplace while scattering others farther afield is a very ancient form of insurance against sudden extinction. Nowadays we call it "differential dispersal," but the version practiced by the western tent caterpillar is only one of many developed by plants and animals evolving in harsh environments.

When any one of these biological strategies is examined closely, some of its strengths may also prove to be weaknesses. For the western tent caterpillar, the production of short-range fliers can get out of hand in an isolated population. If too many active moths of each generation leave, the activity of the remaining residents drops sharply in a few generations. Ultimately, colonies become too sluggish to survive, and the local population collapses.

Despite such local difficulties, the method has kept the species extant in the rugged terrain of coastal British Columbia. And that is no mean feat in a fantastic mosaic of hill and valley climates, many of them unfavorable, and all of them unpredictable. We humans should not be too quick to impose our standards on the caterpillars' solution to their environmental problem, for what may seem like a high price to us may, in fact, be a small one to them, especially in relation to the fringe benefits they derive from differential activity.

When a colony is properly balanced, the active members lead the group to new forage, and they also increase the frequency of the feeding periods by keeping the rest periods brief. The less active individuals not only improve the quality of the tent by weaving a closer mesh than their more restless fellows, but their greater numbers absorb some of the onslaughts by predators or parasites, thus saving the more vigorous few. The system therefore is basically sound for the population at large. And it has provided us with a fascinating example of the impact of individual behavior on group survival. ☐

Nothing's sacred!

How's that for an editorial policy?

A magazine with that two-word editorial policy has two terrific advantages.

First, it enables the magazine to attract the best reporters and writers there are.

And second, it enables those writers to write the most outrageously brilliant stuff they've ever written.

Which is exactly what's happening at NEW TIMES, the brand new news magazine that is published every other week, and is, we can assure you, like nothing you've ever read.

In NEW TIMES you'll be reading the best group of writers ever gathered in one magazine at one time.

Jimmy Breslin, Joe McGinniss, Mike Royko, Sara Davidson, Larry L. King, Studs Terkel, Nicholas von Hoffman, Murray Kempton, Pete Hamill, Dick Schaap, J. Anthony Lukas, Jack Newfield, Joan Barthel, F. Reid Buckley, Marshall Frady, Brock Brower, Nora Sayre, Thomas Thompson.

NEW TIMES won't cover the news in the traditional way, we won't summarize it or review it. Our writers will dig up new news. And present it to you in words that jump off the page, words that are unexpected, revealing, full of insight. And irreverent.

We told our writers to turn out the kind of magazine they've always said they'd love to write for. We told them no individual, no institution, no idea was sacred. And not to worry about who or what they might offend.

So they're not worrying. With the result that a NEW TIMES look at Watergate might ask the question, "If Richard Nixon is kicked out of office, will he be eligible to collect unemployment insurance?" And when NEW TIMES takes an inside look at John Connally, we tell you "Connally didn't smoke but he carried a cigarette lighter. He'd offer a light only to somebody who was very, very rich."

In short, NEW TIMES won't bore you. We'll avoid the obvious and focus on the stories and viewpoints you don't expect, the ones conventional magazines never think of.

We'll cover whatever we know will interest you—politics, sports, consumerism, business, crime and the mob, labor, personalities, show business, art, architecture, science, medicine, daily living. There will be special newsletters that, in themselves, will be worth the price of admission. There will be articles dealing with issues of epic significance and pieces that stay light, because we're going to entertain you as well as inform you.

It's all just starting and we'd like to enroll you as a Charter Subscriber right now, with a very tempting offer.

NEW TIMES on the newsstand will cost 60¢ an issue, $15.60 a year 26 issues. The regular subscription price will be $12 a year. With this offer you get it for half the regular subscription price—just $6 a year. A 50% saving.

So fill in the coupon and mail it to us right away. And we'll start sending you the first new news magazine to come along in 40 years. Right away.

NEW TIMES

The news magazine that's going to make news.

SPECIAL INTRODUCTORY CHARTER OFFER.
SAVE $6.

Yes, I want to be a Charter Subscriber to NEW TIMES. Start my subscrption and send me 26 issues for only $6—half the regular subscription price of $12. I understand that, as a Charter Subscriber, I will receive the lowest possible prices on renewals and gift subscriptions and that I may cancil at any time, for any reason, and receive a full refund on any unmailed issues.

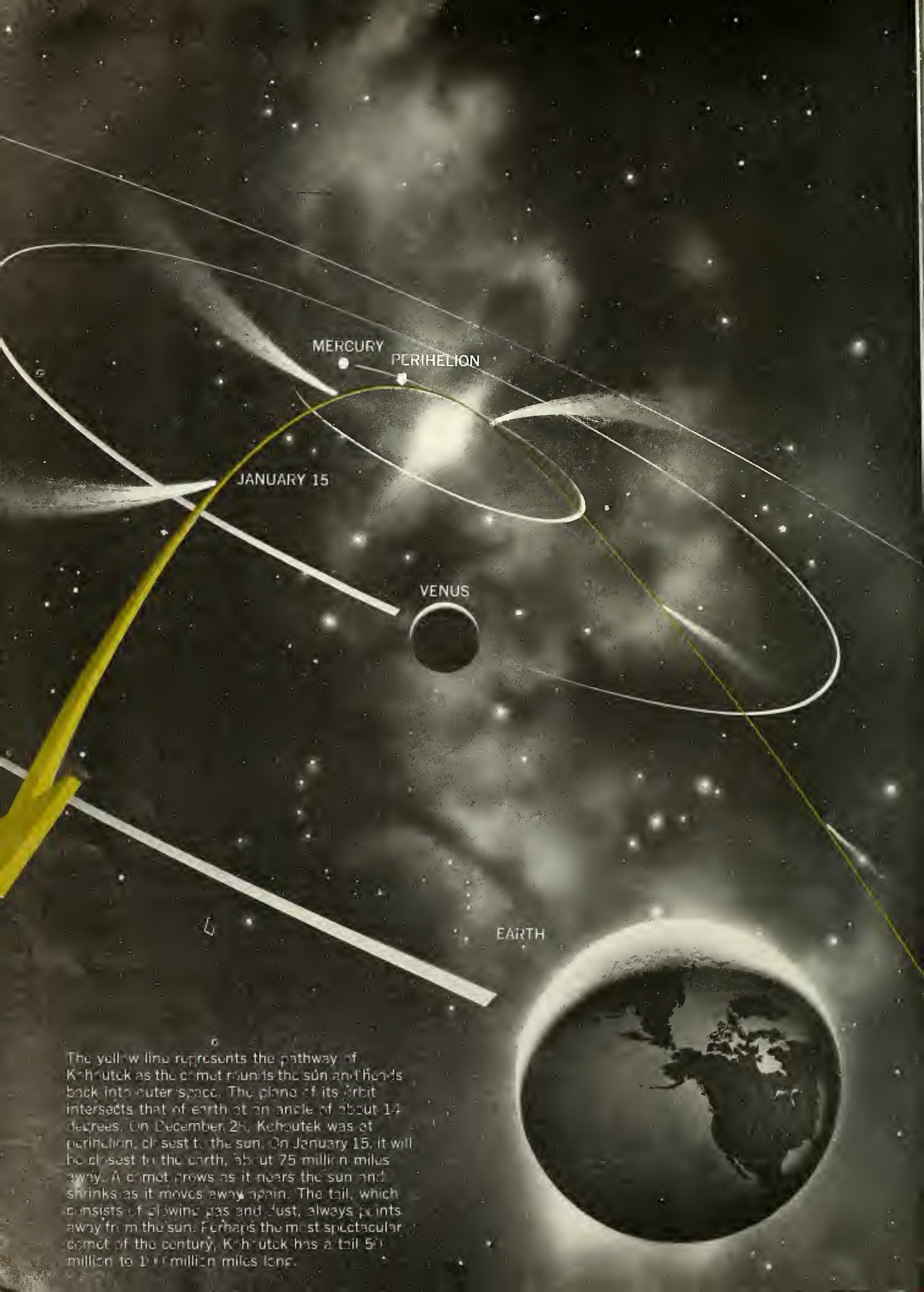
☐ Payment enclosed ☐ Bill me later 6028

Name

Address

City State Zip

Mail to: New Times
P.O. Box 2948
Boulder, Colorado 80302



The yellow line represents the pathway of Kohoutek as the comet rounds the sun and heads back into outer space. The plane of its orbit intersects that of earth at an angle of about 14 degrees. On December 28, Kohoutek was at perihelion, closest to the sun. On January 15, it will be closest to the earth, about 75 million miles away. A comet grows as it nears the sun and shrinks as it moves away again. The tail, which consists of glowing gas and dust, always points away from the sun. Perhaps the most spectacular comet of the century, Kohoutek has a tail 50 million to 100 million miles long.

by Kenneth L. Franklin

A Visitor from Outer Space

The last men to see Comet Kohoutek may have lived about 5 million years ago in Olduvai Gorge in the part of Africa that is now Tanzania. Since then a lot has happened to man, and the comet has been on an extended voyage through space—a trip that has taken it over 5 million million miles from the sun.

Our usual impression of a comet is of something hurtling through the skies, and we are somewhat surprised not to see such action as we watch through telescopes and binoculars or just stand and stare. Actually, comets do move rapidly, but they are usually so far from us that we cannot discern their motion without instruments. Comet Kohoutek was traveling about 100,000 miles per hour in early December, 1973, and speeded up to 250,000 miles per hour on December 28, when it came within 13 million miles of the sun. Just as a roller coaster car moves most rapidly at the bottom of a steep loop, so a comet travels fastest when it comes closest to the sun. This high energy of motion allows the car to coast "uphill' and make it over the next rise, and it permits a comet to move away from the sun to complete its orbit.

The top of the rise for Comet Kohoutek was 56,000 astronomical units away from the sun (1 AU = 93 million miles, the distance from the earth to the sun). At that distance all is cold and bleak. The temperature of the solid chunk we call the nucleus of a comet was nearly absolute zero. Perhaps a few thousand of Kohoutek's periods ago, this lump and hundreds of billions of others were formed in the outer reaches of what is now the solar system from a huge cloud of gas and dust. After a few billion years, the inner parts of this cloud condensed into the sun, and the planets also appeared. Untold numbers of comets were probably formed in this deep freeze of space; untold numbers, made of the frozen gases and dust grains of the primordial cloud, have already paid visits to the sun's neighborhood; untold numbers have run their course and vanished without trace; and untold numbers remain.

At the top of its rise, when Comet Kohoutek is farthest from the sun, it moves only about a half mile an hour. It therefore spends most of its existence in far distant space where it was born. But minute changes in the local gravitational field, due to changes in the positions of nearby stars and even of the spiral arms of our galaxy, can cause minute changes in the motion of such a comet. These may keep a comet in outer space forever, or divert it to the invisible outer reaches of our planetary system. Probably no such disturbances will break the sun's dominant hold on Kohoutek, so this comet and its cloud are still the sun's property.

Since Kohoutek moves very slowly when far from the sun, it remains in nearly the same place for thousands of years. In the same time span, all the planets make their own journeys around the sun many times over. The comet responds to this blur of planetary motion as if the masses of all the planets were lumped with the mass of the sun. As the comet begins its visit to the sun, it picks up speed ever so slowly. The first planet it "sees" or responds to gravitationally is Jupiter, the largest planet in our solar system. Jupiter has a period of about twelve years and contains more matter than all the other planets combined. In order to be seriously affected by Jupiter, and next by Saturn, the comet must be pulled to a new path at the end of a few years, never to return to the one that it followed on its distant approach. By the time it is a few hundred astronomical units from the sun (Pluto's average distance is 39 AU), it is necessary, in predicting the comet's path, to rely on computers to take into account the perturbing effects of all the outer planets.

Eleven months before perihelion passage, the point of nearest approach to the sun, Comet Kohoutek was as far away from the sun as Jupiter (5 AU). Then all the planets had to be reckoned with, as their rates of motion seemed to slow down, relative to the acceleration of the comet. On January 28, 1973, Comet Kohoutek was photographed by Lubos Kohoutek, a Czech-born astronomer working at the Hamburg Observatory in West Germany, but it was not discovered by him until he examined another photograph taken on March 7. Astronomers who calculate orbits could not then tell the difference between the comet's path and a parabola. Although many observations were made up to early May, when the sun moved into our line of sight to the comet, no accurate deviation from a parabola could be sensed until late September and October, when new observations were obtained. Now accuracy is sufficient to calculate all that has happened and will happen to Comet Kohoutek until it reacts again to nearby stars.

Since the planets can no longer be considered as having their masses lumped with that of the sun, the gravitational attraction toward this hub of the solar system is lessened. The diminished mass at the hub allows the comet to follow a path that is not as tightly curved as the one it followed when it was far away from the planets. When Comet Kohoutek rounds the sun it will actually be on a path known as a hyperbola, whose shape, like that of a parabola, is open at the far end. If the comet cannot close back onto itself, as in an ellipse or circle, it will not be able to come home again. Several comets have been known to leave on such a path. They were then lost to the sun and disappeared into interstellar space.

When Comet Kohoutek leaves the vicinity of the sun, its future orbit will be smaller in every respect than the one it had on arrival. As it gets farther from the inner solar system, it will again "see" the planets lumped one by one into the sun and the effective central force on it will increase. This gravitational pull will tighten the comet's curved path into a very elongated ellipse. Its period will be about 90,000 years and it will go only 3,600 astronomical units into the cold void.

Kohoutek's encounter with the planets on this visit robbed it of the energy it needed to climb its old big rise. Next time around, the comet might pass so close to Jupiter that it will be captured by the planets and become a short-period comet. ☐

Celestial Events

by Thomas D. Nicholson

Sun and Moon With the sun's motion northward in the sky again, the lengthening of the days becomes more obvious during the period from mid-January to mid-February. Most apparent is the later occurrence of sunset and, for those who rise early enough, the earlier sunrise. We will have dark, moonless skies after sundown in January until the early crescent moon becomes visible about the 26th. But moonlight will increase nightly thereafter until the high, bright full moon of February 6. Phases occur as follows: last-quarter, January 15; new moon, January 23; first-quarter, January 31; full moon, February 6; and last-quarter again on February 13.

Stars and Planets In late January and early February, the brightest of the winter stars are in their best positions during the early hours of the evening, well up in the sky, moving slowly toward and past the meridian, where they are highest. Orion, with its seven bright stars, is about midway up the sky in the south a few hours after dark, and very easy to recognize in its upright position. Nearby, and easy to relate to the great figure of Orion, are the other brilliant winter stars, including Capella, Castor and Pollux, Procyon, and Sirius. Sirius is low in the southeast after sundown and, except for the moon, will be the brightest object we will see at night during this period.

Earlier in the winter, Venus, Jupiter, and Mars outshone Sirius in our evening sky, but Venus and Jupiter are too close to the sun in mid-January, and both become morning stars soon after. Mars, moving rapidly away from earth now, is fading fast in brightness, although it remains in the evening sky, appearing high in the south at dusk and setting about midnight. Saturn, too, is an evening star, becoming visible in the east after sundown and remaining in the sky until a few hours before sunrise. Mercury, also an evening star, may be seen about an hour after sundown, low in the west, for about a week before and after February 9.

Comet Kohoutek Still an evening object by mid-January, the comet has been low in the southwest after sundown since passing the sun on December 28. The comet's motion is bringing it into greater prominence as an evening object with each passing night, but is also taking it farther from sun and earth, dimming its brightness as a result. You may expect to find the comet higher and remaining above the horizon for longer periods each night, but it will be fading substantially by the end of January and will probably require optical assistance to find thereafter.

January 23: Venus is in inferior conjunction with the sun (passing between sun and earth) and enters the morning sky.

January 24: Jupiter, although very low in the southwest, may be seen near the crescent moon this evening if skies are exceptionally clear.

January 31: Mars is to the right and below the moon at dusk this evening.

February 3: Saturn is just above the moon in the eastern sky early this evening.

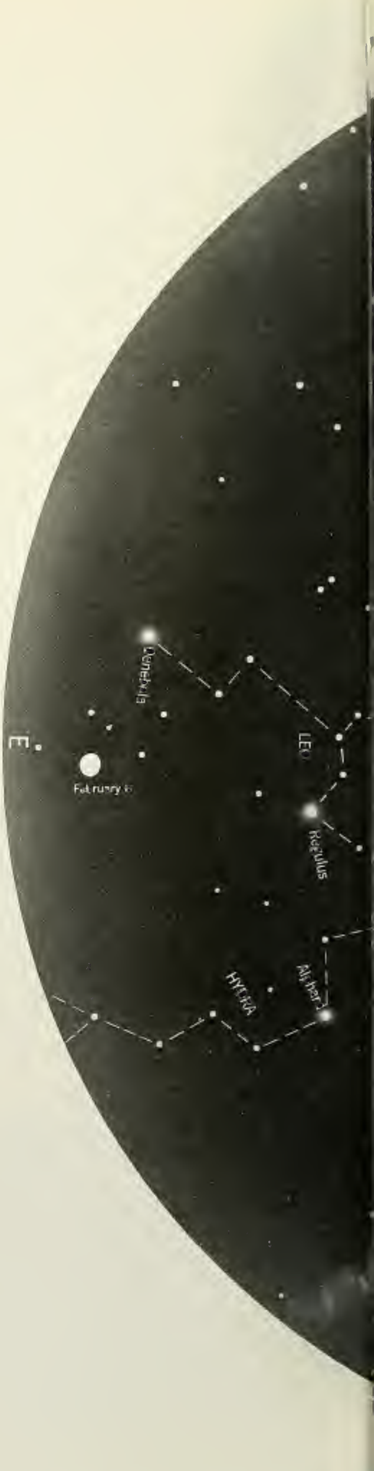
February 5: The moon is at perigee, nearest earth.

February 9: Mercury is at its greatest distance east (left) of the sun. This leaves the planet well placed for viewing about an hour past sundown, low in the west, for about a week before and after this date.

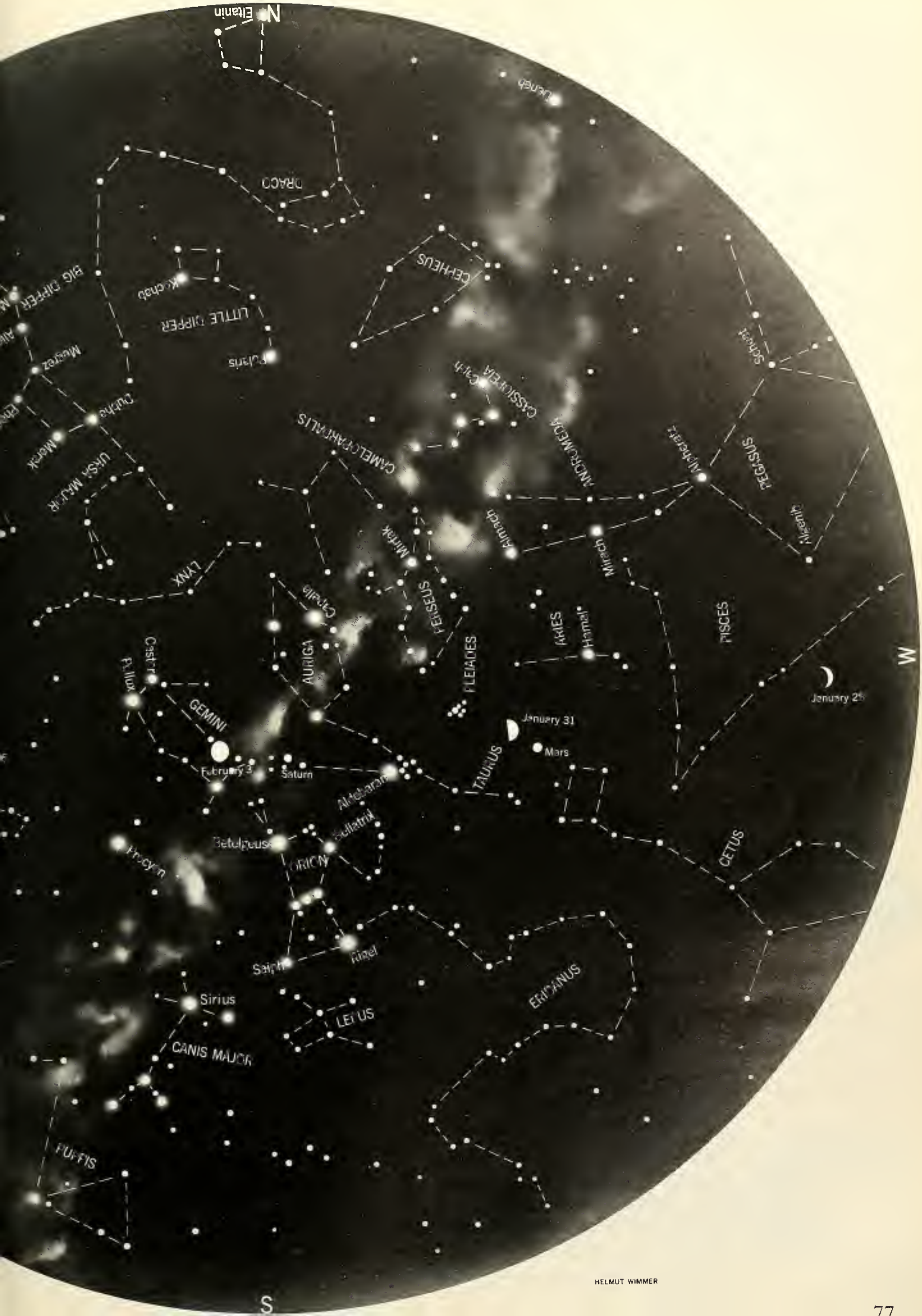
February 12: Venus, having passed between sun and earth, is now visible low in the southeast in the early dawn, rising just before the sun.

February 13: Jupiter is in conjunction with the sun and enters the morning sky.

February 15: Mercury begins its retrograde motion.



★ Hold the Star Map so the compass direction you face is at the bottom, then match the stars in the lower half with those in the sky near the horizon. The map is for 10:15 P.M. on January 15; 9:15 P.M. on January 31; and 8:15 P.M. on February 15; but can be used for about an hour before and after these times. (Adjust for daylight time.)


N
Eltanin
Deneb
DRACO
CEPHEUS
Kochab
LITTLE DIPPER
Polaris
BIG DIPPER
Megrez
Dubhe
Merak
URSA MAJOR
Caph
CASSIOPEIA
CAMELOPARDALIS
ANDROMEDA
Alpheratz
Scheat
PEGASUS
Algenib
Almach
Mirach
Mirfak
PERSEUS
LYNX
Capella
AURIGA
ARIES
Hamal
PISCES
W
January 2
PLEIADES
Castor
Pollux
GEMINI
January 31
Mars
TAURUS
February 3
Saturn
Aldebaran
Bellatrix
Betelgeuse
Procyon
ORION
CETUS
Rigel
Saiph
Sirius
LEPUS
ERIDANUS
CANIS MAJOR
PUPPIS
S

HELMUT WIMMER

Fish Are What They Eat

The bodies and mouths of fishes in a northern lake are carefully adapted to the available food

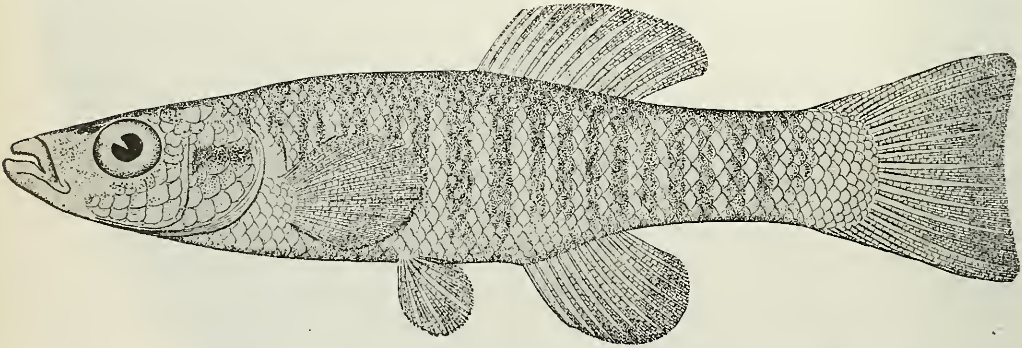
Lake Opinicon, six miles long and one mile wide, is one of the thousands of small lakes that grace Ontario's landscape. Queen's University, with which I have been associated for 13 years, maintains a field station on this delightful, clearwater lake, and this is how I, and successive groups of students, came to develop a series of long-term studies on the feeding, growth, and reproductive ecology of its eighteen species of fish. During this time one of our special interests has been those facets of morphology, behavior, and ecology that combine to minimize inter- and intra-specific competition, and thus permit a wide diversity of species to live together.

Fish are an ideal vertebrate group for the comparative study of morphology relative to ecology. Their body shapes reflect different swimming habits and ways of life. The size, shape, and position of a fish's mouth correlate with the kind and size of the food it eats. A further modification relating to feeding involves the gill rakers, bony processes that project from the wall of the pharynx to hold back coarse material that could damage the delicate gills. An increase in the number and length of the individual rakers produces a strainer that can sift out minuscule zooplankton and divert them down the throat.

The teeth also are adapted structurally to food types. Most fish species have two kinds of teeth: marginal ones at the edge of the mouth, which are used for seizing and biting prey; and pharyngeal teeth, which occur at the back of the throat as dorsal and ventral pads. These pads, and their component teeth, differ in size, shape, and arrangement and when pressed or rubbed together during use, crush, grind, or chop food. (In this arrangement the biting and chewing functions are fulfilled by different sets of teeth, in contrast to that in mammals where the biting and chewing functions are carried out by incisors and molars located on the marginal row.)

Specializations may involve both marginal and pharyngeal teeth. For example, in the piscivorous (fish-eating) pike, the marginals are long and needle sharp, and both marginals and pharyngeals are backwardly directed; hence their slippery prey cannot escape, and once seized can only travel one way—down the throat.

Sense organs also reflect feeding



Eastern Banded Killifish, *Fundulus diaphanus diaphanus*, a Surface Feeder

Position of mouth: dorsoterminal
Body shape: fusiform
Food: water insects, plankton, aquatic vegetation
Habitat: shallow, weedy bays of lakes, coves of rivers, and estuaries
Distribution: From South Carolina north to the Maritime Provinces and Newfoundland; west through the eastern parts of Pennsylvania and New York

habits. The whiskerlike, chemosensory barbels of the nocturnal, bottom-feeding brown and yellow bullheads are adapted for feeding by taste, not sight. This ability explains how bullheads are able to obtain food and thrive in opaque and muddy waters where it is impossible to see prey. With the premium no longer on sight, their eyes have become small and of reduced effectiveness.

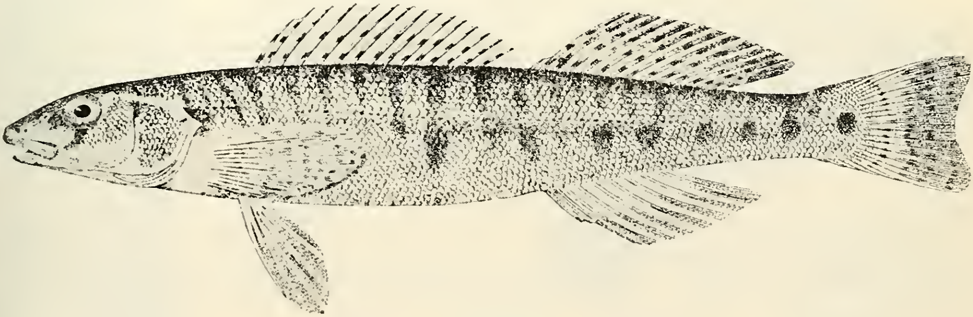
In contrast to the small eyes of the bullheads, evening- and night-feeding visual feeders—the rock bass, alewife, and brook silverside—have enlarged eyes, giving increased light-gathering power.

These correlations seem obvious now, after prolonged study, but many of them were revealed only slowly. For example, we determined by accident the significance of the small knob on the snout of the 6-inch-long, erratically swimming log perch. Stomach analyses showed it lived largely on bottom-dwelling midge larvae, amphipods, isopods, and the tiniest mayfly nymphs, organisms also eaten to some degree by other species of fish in the lake. This suggested a degree of food competition. One day I happened to put some log perch into an aquarium tank, the bottom of which was covered with leaves and fine gravel. As I watched, the perch dropped to the bottom; then pushing their knobbed heads under the edges of the leaves and small stones, they flipped them over and fed on the organisms living underneath. The explanation of the knob was suddenly clear: it enabled the log perch to obtain food inaccessible to other species.

Body size, to a considerable degree, also predetermines ecological roles. Large size permits a fish to be a predator of other fishes, gives it the capacity to range widely in the course of feeding, and since it is too large for many other fishes to eat, offers protection from predation. This is true of the pike and largemouth bass in Lake Opinicon. On the debit side, such species need large prey: it is energetically uneconomical for them to pursue the more abundant smaller food items even if they had the equipment to catch them.

The tiny black-chinned shiner, by contrast, is specialized by virtue of its diminutive body size and small mouth. The shape of its body and fins gives it the maneuverability to catch the abundant Cladocera and Copepoda, minute swarming organisms, which twist and turn through the curtain of water plants that is the shiner's habitat. But the shiner's small size brings vulnerability to a range of predators.

Of the larger species of fish, the basses, crappies, perches, and others, only the adults are relatively predation free. At these latitudes



Log Perch, *Percina caprodes*, a Bottom Feeder

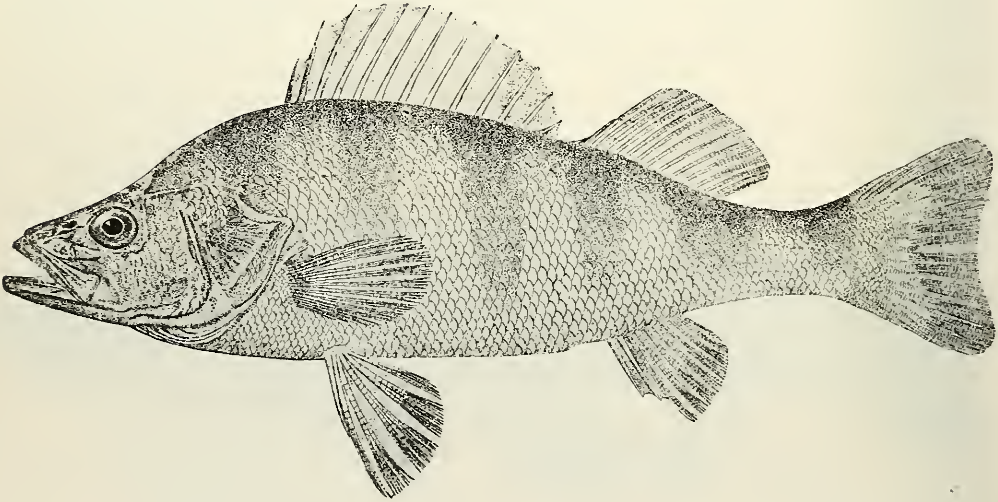
Position of mouth:	ventroterminal
Body shape:	fusiform
Food:	minute crustaceans, insect larvae
Habitat:	gravel bottoms of shallow waters in lakes and medium-sized streams
Distribution:	Hudson Bay to Great Lakes Basin; north-central and northeastern United States

their growth season is limited to ten weeks a year, and it takes several years for them to reach moderately large (and breeding) size. Hence, simultaneously in the populations of these species are whole series of distinct year classes of different sizes. For example, at the end of their first summer of growth (September), rock bass range in length from 1½ to 2 inches, a size that remains unchanged until the following June. At the end of the second summer the size range is 2⅓ to nearly 3 inches; at the end of the third summer 3 to 3½ inches, and so on. Because of the possible dangers of intraspecific competition between these year classes, it is noteworthy that their diets change with growth. In terms of their ecological niche, the smaller first-year fish are, to all intents and purposes, "minnows," feeding on the smaller zooplankton and midge larvae. The intermediate-sized individuals (years two to four) feed on larger aquatic insects such as mayfly and damselfly nymphs. Larger (seven- to ten-year-old) individuals graduate to crayfish and are partly piscivorous. Thus, apart from taking different kinds of organisms, rock bass take foods of ever larger size as they grow, each year class taking organisms of the size it is best equipped to handle.

Because diet changes with growth, intraspecific competition is minimized. (In the bluegill sunfish the year classes differ only slightly in diet, but small, medium-sized, and larger individuals live in different habitats.) The dietary transition from zooplankton feeding to aquatic insect feeding also characterizes the true piscivores, except that the changes are compressed into a few weeks. One can theorize from this that piscivores evolved by a continued shortening of the prepiscivorous phase, coincident with an accelerated body growth rate.

The three most common fish body shapes are: (1) torpedo, or fusiform; (2) bilaterally compressed and gibbous, or deep bodied; (3) sharklike, with flattened head and pinched hindbody. Each has a different set of hydrodynamic properties, and all three are present in Lake Opinicon. The first characterizes the majority of the species, the second is exhibited by the sunfish and crappie, and the third by the bullhead.

Characteristic of fish species that swim more or less continuously or range widely, the fusiform body is the most efficient for rapid progression through water. As in all fish, propulsion is by means of alternating lateral contractions of the muscular body, supplemented by the movements of the caudal (tail) fin.



Yellow Perch, *Perca flavescens*, a Mid-water Feeder

Position of mouth: terminal
Body shape: fusiform
Food: insects, crustaceans, small fish
Habitat: slow-flowing streams and up to 60-foot depths in lakes
Distribution: Alberta and the Hudson Bay drainage system south to South Dakota and the northern parts of Missouri, Illinois, Indiana, Ohio, and western Pennsylvania; and from New Brunswick to South Carolina

Look what you get when you subscribe to Natural History*

Look first at the magazine you're holding in your hand. And think about all the new ideas you'd discover...all the usable information the whole family would have...all the interesting conversations you could spark, if you were sure of getting 10 issues like it during the coming year.

Then think, if you will, about the *extras* that come with a subscription to *Natural History:* A year-long Associate Membership in The American Museum of Natural History. Free admission to the Museum any time you can visit us. Use of the Member's Reception Lounge. Two free bonuses a year (usually important books in special Members' editions). Discounts at the Museum Gift Shop. *And* the satisfaction of knowing that you are helping to support the Museum's exhibits and research and teaching and ongoing efforts to help preserve the Earth we all depend on.

It's a great deal to get and a great deal to accomplish in exchange for a modest $8 a year. Won't you fill out and mail one of the cards below today? Maybe you'd like to pass the other one on to a friend.

* *Sorry, totem pole not included.*

Enter my subscription, which includes an Associate Membership in The American Museum of Natural History, and bill me.

☐ **1 year $8** ☐ **2 years $15*** ☐ **3 years $21***

*EXTRA BONUS for two- and three-year subscribers, at no additional cost: a soft-cover edition of A GOD WITHIN, the much acclaimed book in which the noted scientist and author, René Dubos, presents his insights into man's relationship with nature.

Mr/Ms____________________________________

Address__________________________________

City__________________State________Zip________

☐ This is a renewal, and the information above is copied *exactly* from my NATURAL HISTORY magazine wrapper label. J007

Enter my subscription, which includes an Associate Membership in The American Museum of Natural History, and bill me.

☐ **1 year $8** ☐ **2 years $15*** ☐ **3 years $21***

*EXTRA BONUS for two- and three-year subscribers, at no additional cost: a soft-cover edition of A GOD WITHIN, the much acclaimed book in which the noted scientist and author, René Dubos, presents his insights into man's relationship with nature.

Mr/Ms____________________________________

Address__________________________________

City__________________State________Zip________

☐ This is a renewal, and the information above is copied

NATURAL HISTOR

FIRST CLASS
PERMIT NO. 4946
DES MOINES, IOWA

BUSINESS REPLY MAIL
No Postage Stamp Necessary if Mailed in the United States

POSTAGE WILL BE PAID BY—
NATURAL HISTORY
P. O. Box 5000
Des Moines, Iowa 50306

FIRST CLASS
PERMIT NO. 4946
DES MOINES, IOWA

BUSINESS REPLY MAIL
No Postage Stamp Necessary if Mailed in the United States

POSTAGE WILL BE PAID BY—
NATURAL HISTORY
P. O. Box 5000
Des Moines, Iowa 50306

and the compact, muscular, fusiform shape provides maximum power with minimum water resistance.

The gibbous body form is a particularly stable shape in that the whole body acts like a keel. The expanded surface, however, means that it is inappropriate in running water, for if the fish turned sideways it could be caught and swept away by the current. Hence, this body form is restricted to fishes inhabiting still waters such as lakes and coral reefs. In contrast to most of the fusiform-bodied fishes, sunfish, for example, feed by hanging or hovering, nearly motionless, in mid-water waiting for prey to appear.

The superficially sharklike body form of the brown bullhead, with its dorsoventrally depressed head and bilaterally compressed body, would seem, in part, to be an adaptation to its essentially bottom-feeding habits. The flattened head permits a very wide mouth, necessary in a species dependent on chemosensory, not visual, feeding. Bullheads feed by moving horizontally or at an angle over the bottom with their barbels touching or immediately above the substratum. In this way they can taste the presence of prey. Bullheads seize mud-dwelling midge larvae and spit out the mud. They grab larger items with a quick biting action, often turning head downward in the process.

Fish also differ greatly in the sizes, shapes, and positions of their mouths. The larger mouths are snapping or biting devices. Huge mouths characterize the piscivorous pike and largemouth bass. The rock bass has a fairly large mouth because in adulthood it feeds primarily on crayfish—and crayfish are big prey. At the other extreme, the bluegill has a relatively small, tubelike mouth corresponding to the wide range of tiny prey organisms on which it feeds.

There is also a suctorial component involved when fish feed. As the pharynx expands coincident with the strike, a prey organism is, in part, swept into the mouth in a current of water. The suctorial component is most important in fish that have narrow and, especially, tubelike mouths; the narrower the bore of the mouth, the more powerful the water flow. This is a particularly effective method for capturing smaller prey items. Thus, the basic respiratory movement involved in drawing water rapidly into the mouth by expanding the pharynx becomes an important supplement to feeding.

The positions of fish mouths are either dorsoterminal, opening at an angle toward the top of the head; terminal, opening at the front end of the head; or ventroterminal, opening on the lower side of the head. The upwardly directed mouths of the brook silverside, golden shiner, and killifish are adaptations for surface feeding. The mouths of the bullhead, mudminnow, and yellow perch are terminal, enabling these species to feed with equal facility at any level in the lake and, by tilting the body, from the surface or bottom. The bluntnose minnow mouth points downward; stomach analyses show that this species feeds on the rich organic detritus on lake bottoms. The ventral mouth of the bluntnose makes it impossible for this fish to feed from the surface.

Body size is adaptive, as is body shape, fin morphology, the size, shape, and angle of the mouth, the marginal and pharyngeal teeth, the gill rakers, and those parts of the sensory system that detect prey and predators. These structures specifically preadapt the various species to certain ecological niches in Lake Opinicon.

A corollary of this is that if one knew enough about the use or meaning of such structures, one could predict a great deal about the ecology of a particular species. Structural specializations fit species for different ways of life, feeding habits, and foods. They channel them into different feeding niches, minimizing interspecific competition and even reducing intraspecific competition, as for example between the small and large members of a species. A wide range of species and size classes of species can thus live side by side.

The situation in Lake Opinicon, where structure and ecology are closely linked, is doubtless typical of a mature, diversified faunal assemblage that has interacted over a long period of time. The link between morphology and ecology is obvious in these fishes and helps explain how this particular ecosystem can support the number of species found within it. ☐

"IT'S A NICE WAY TO GO IF YOU GOTTA GO!"
GRAHAM HUNTER

HAVAHART traps are humane. They catch all kinds of unwanted animals *alive* and *unhurt*. No rust problem—they're galvanized. And there's a size for all needs. The open ends give animals confidence. Children and pets can't be hurt. You'll enjoy using a HAVAHART. . . . Write TODAY for your FREE trapping guide with full information about this great trap. Thousands in use.

HAVAHART, 158 Water St., Ossining, N.Y. 10562

Please send new guide and price list.
Name____________________
Address________________Zip________

19 CHAMPIONS OF LIBERTY

TERRIFIC OFFER, trivial price! Complete U.S. "Champions of Liberty" set of colorful stamps issued 1957-61 honoring 10 world heroes like Paderewski, Garibaldi, Gandhi. Includes both 4c and scarce 8c values PLUS giant Magsaysay stamp. Retail $1.00—all 19 stamps yours for 25c. Plus fine stamp selections to examine free. Buy any or none, return in 10 days. Cancel service any time. Rush reply—sorry, only one to a collector. GARCELON STAMP CO., Dept. 1NHL, Calais, Maine

ESKIMO ART & ARTIFACTS

Our 40 page catalogue consists of photographs and prices of our current collection of contemporary and ancient Eskimo art and artifacts. The catalogue price is one dollar.

WALRUS IMPORTS ESKIMO GALLERY
Box 145
Kennebunkport, Maine 04046

"APACHE"

AUTHENTIC STONE ARROWHEADS

All Perfect and Different

Frame, Laminate, Make Jewelry, Collect

25 for $5.25

100 for $15.00

Premium Inquiries Invited
TRIBAL HALL-S
NH Apache Junction, Arizona 85220

BOOK HUNTING?

Virtually any book located—no matter how old or long out-of-print. Fiction, nonfiction. All authors, subjects. Name the book—we'll find it! (Title alone is sufficient.) Inquire, please. Write: Dept. 65.

BOOKS-ON-FILE
UNION CITY, NEW JERSEY 07087

YOU DON'T HAVE TO BE RICH TO HAVE A GREENHOUSE!

Write for our catalog.

TURNER GREENHOUSES
Mt. Olive Hwy., Goldsboro, N. C. 27530

Share the Thrills of Exploring Outer Space!

$219.95 f.o.b. Hartford, Conn.
$15 Crating Charge

All DYNASCOPES, including this superb RV-6, 6-inch available on easy terms!

Now it's easy to join the thousands of serious amateurs who have discovered the excitement of exploring our mysterious universe. Your enjoyment begins right from the start, yet the challenges and rewards go on for years! And it's a hobby that can be shared at modest cost.

Choose From Many DYNASCOPES®

Picking a telescope to fit your needs and your pocketbook is simple when you select a DYNASCOPE—the same instruments used by more than 150 schools, colleges and observatories—and your satisfaction is guaranteed by a full-refund warranty.

FASCINATING GUIDE YOURS FREE!

Read these valuable facts before buying any telescope. Mail coupon or postcard for your complimentary copy of this helpful guide.

Dynascopes

Criterion Manufacturing Co.
331 Church St., Hartford, Conn. 06101

® TM Registered U.S. Pat. Office

CRITERION MANUFACTURING CO., Dept. NH-44
331 Church St., Hartford, Conn. 06101
Please send your free Telescope Guide.
Name
Address
City State

ELEGANT SIMPLICITY FOR THE HOME OR OFFICE, OR AS A PERFECT GIFT IDEA

BONSAI Hardy, Beautiful! Imported from Japan.

A living miniature tree. Twenty-years old complete in its own stoneware planter, with instructions on care. These amazing values come to you from Heirob Bonsai Nursery, America's largest importer of Bonsai trees.

12" Japanese Pine, 10" Grecian Boxwood 8" Japanese Elm, 8" Japanese Flowering Quince or 8" Blue Moss Cypress **$34.50 each/$62.50 for two/$150 for all five,** *delivery included.*

We Ship to Canada

HEIROB BONSAI NURSERY
Willowemoc Rd., Livingston Manor, N.Y. 12758
(914) 439-5706 Phone Orders Accepted

☐ 12" Japanese Pine ☐ 8" Japanese Elm
☐ 10" Japanese Cedar
☐ 8" Blue Moss Cypress ☐ 10" Grecian Boxwood
☐ 1 Tree @ $34.50 ☐ 2 Trees @ $62.50
☐ All 5 for $150.00 ☐ Complete Catalogue

Enclosed is my check or money order for $ including sales tax, if any.
Bill my credit card account for the full amount of $.
Plus sales tax, if any.
☐☐☐ ☐☐☐ ☐☐☐ ☐ ☐☐☐
Expiration Date
Name
Address
State Zip
City
Signature

Announcements

The 1974 Natural History Color Photography Competition

In the February issue of the magazine, readers will find the rules and categories for our most ambitious competition, which opens February 15. The two grand prizes are round trip air tickets, for two, to East Africa and to Belgium. First prizes in the three categories are $250 each. The themes are: The Natural World; Man and His Environment; and Pictorial Sequence of Nature. The competition is open to all amateurs, including professional photographers. In other words, anyone who loves photography and good pictures.

Cruise on the Adriatic

The American Museum of Natural History invites a limited number of its Associate Members to join several scientists from the Museum's staff on an "Adriatic Odyssey" aboard the m/v *Neptune* from May 16 to 27, 1974. Embarking from Venice, the *Neptune*'s ports of call will include five stops along the Dalmatian coast, plus Corfu, Ithaca, Delphi, Hydra, Thera, and Athens. For more information, please write: Gregory Long, The American Museum of Natural History, Central Park West at 79th Street, New York, N.Y. 10024.

The Metro Forest

A limited number of reprints of "The Metro Forest," the special supplement that appeared in the November issue, are available from *Natural History* Magazine, Central Park West at 79th Street, New York, N.Y. 10024. The postpaid price is 50¢ each, with slightly lower rates on requests for more than 25 copies.

Museum Highlights

. . . The Museum's January Exhibit of the Month is a re-creation of the city of Alexandria as it appeared nearly two millennia ago. The display, including hundreds of individually crafted temples, palaces, and ships, is the first of five re-creations of ancient cities that will be featured in the Hall of Peoples of Asia, scheduled to open in 1976.

. . . The Hayden Planetarium is offering visitors a voyage on Spaceship Earth. Beginning January 3, the new Sky Show explores the question of planetary survival in the solar system. For further information write to the American Museum—Hayden Planetarium.

. . . *Chimps and children.* Many behavioral scientists are excited about the results of language experiments using chimpanzees. We are, it seems, learning much about language from a rather unlikely source. Dr. David Premack of the Center for Advanced Study in the Behavioral Sciences, Stanford University, one of the most respected researchers in this field, will give a special lecture—"Language and Knowledge in Chimpanzees and Children"—on Wednesday, January 30, at 8:00 P.M., in the Museum auditorium. This event, cosponsored by The American Museum and the New York Academy of Sciences, will be open to the general public at no charge.

. . . "The Pain—and the Promise—of Change," a three-part lecture series, will be presented by Dr. Margaret Mead on February 5, 12, and 19, at 8:00 P.M., in the Museum auditorium. Dr. Mead will discuss the social consequences of rapid urbanization, comparing the past, the present, and the projected future of transitional societies. Tickets for the series are $25 ($12.50 for students). For more information write to the Office of Public Affairs, The American Museum.

If you like wine and good food, feast on
the membership benefits of

The Culinary Arts Society

An opportunity to enjoy gourmet foods, cheese, wine, books, merchandise at discount prices

THE WORLD'S GREATEST "CLUB" MAGAZINE

Each month brings 64 colorful pages (or more) of articles, recipes, menus, wine tasting and travel notes, restaurant reviews and news plus recommendations of 50 or more good (but not costly) wines. You will enjoy many articles and departments each month such as Baron Roy Andres de Groot's Feast of the Season, Beverly Barbour's Cooking with Spirits, Holiday Gift spreads and stories on old and rare wines as well as on those that can be bought today. Also Home Winemaking, Coffee, the world of fine teas and much more—alone worth far more than the modest membership fee. One hundred thousand already subscribe to Vintage separately at $12!

GREAT BOOKS LIKE THIS ONE– BIG SAVINGS!

All the new cookbooks and wine books and culinary classics at discount prices. Earn back your entire membership fee now and enjoy books like these . . .

11206 **Guide to Inexpensive Wines** by Alexis Bespaloff (Pub. $5.95) $4.95
12001 **La Cuisine**, by Raymond Olivier (pub. $27.50) $12.00
11801 **The Wines of America** by Leon D. Adams (pub. $10.95) $9.85
11205 **How to Eat Better for Less** by James Beard (pub. $6.95) $5.95
12301 **Larousse Gastronomique** (pub. $20.00) $15
10502 **Encyclopedia of Wine & Spirits** by Alexis Lichine (pub. $15.00) $13.50

SAY CHEESE!

THE CULINARY ARTS SOCIETY lets you try the New cheese sensations . . . or you can order any of many traditional cheeses offered each month.

Our recommendations and discounts must save at least the cost of membership dues or we'll refund your money.

SAVE ON MERCHANDISE –GUARANTEED TOP QUALITY

A convenient way to purchase the culinary necessities (and luxuries) you want. Our "general store" offers everything from wine racks, corkscrews, wine and bar glasses to records, bottlecutters and pots and pans. All at great savings!

SELECT MOUTH-WATERING GOURMET FOODS

Whether it's peeled asparagus, raspberry-filled chocolate, Alsa-bloc pâté or candied baby chestnuts flavored with Cognac, you can learn all about it—and purchase it—from THE CULINARY ARTS SOCIETY. High quality items from the world over.

PARTICIPATE IN SEMINARS, WINE TASTINGS, VINTAGE WINE AND DINE

THE CULINARY ARTS SOCIETY has social as well as gastronomic benefits. As a member, you'll automatically be notified of our many programs. And you'll save up to 20 per cent on our highly lauded banquets and wine tastings.

SAVE $5

As a charter member you can save $5 on your membership fee by joining now. Annual dues are regularly $15—you pay only $10 if you act at once! And you get all these benefits:

- **Vintage Magazine**—thousands pay $12 per year by subscription alone for this fabulous color magazine—it's FREE with your membership.
- **Discounts** up to 50 per cent (or more) on books, merchandise, wine tastings and gourmet happenings announced in the special member's section of Vintage Magazine —over 50 selections each month.
- **No minimum purchase.** No obligation. No automatic shipping. You buy what you like. Satisfaction guaranteed, of course!
- **Guaranteed lowest rate**—as a charter member you are guaranteed the special lowest renewal rate each year.

AN EXCELLENT GIFT

A membership in THE CULINARY ARTS SOCIETY makes a unique and delightful gift that will be remembered each month. It will be acknowledged by an attractive hand-signed card explaining the membership benefits and magazine subscription. You need not join yourself (we hope you will) to send a gift membership.

8302

CULINARY ARTS SOCIETY
P.O. BOX 2739 · BOULDER, COLORADO 80302

Enroll me as a Member, $10.00 fee enclosed (Reg. $15.00). I save $5.00 by joining now. I get 12 issues of Vintage Magazine (a $12.00 value if ordered separately), plus the other benefits listed above. I am under no obligation to purchase anything. If your recommendations and discounts can't save me $50.00, I can get my money back. Check also enclosed for the following books: ( ) 11206 $4.95 ( ) 12001 $12.00 (a $15.50 savings!). ( ) 11801 $9.85 ( ) 11205 $5.95 ( ) 12301 $15.00 (a $5.00 savings!) ( ) 10502 $13.50 (All books are returnable in 10 days if not delighted.)

NAME ______________________________

ADDRESS ______________________________

CITY ______________ STATE ______________ ZIP ______________

Freedom in a bag for as little as $29.95!

Pyrawa Sport Canoes and our NEW Sea Eagle Cruising Canoes & Dinghies!

Quality inflatables that last!

Whitewater rivers, ocean surf, remote lakes and streams . . . discover the waterways of America! Canoes from $69.95 to $142.95. Dinghies from $29.95 to $99.95. Send now for our **free** color brochure!

Leisure Imports, Inc. Dept. NH-1-74
St. James, New York 11780 (516) 724-8900

A superb gift edition

THE ILLUSTRATED WALDEN

Thoreau Country, beautiful and unspoiled, as it was when the century began—in 66 evocative illustrations by the renowned photographer Herbert W. Gleason.
Boxed $15.00

Princeton University Press

Miracle Seeds . . .

Continued from page 18

Javanese politics gave them precious little time, however, to test their theory. In September, 1965, as 1,200 students were starting the program for the rainy season, the long-smoldering struggle between landowner and landless, between Moslem storekeeper–religious official and Javanese Buddhist–Hindu farmer, between the Indonesian army and the Communist party, finally broke out into the open and ripped apart the fragile coalition that Indonesia's first president, Dr. Sukarno, had vainly tried to patch together. The army won.

During much of the rainy season of 1965–66 Indonesian society was embroiled in a protracted slaughter of known or suspected Communists. On Java alone, between 200,000 and one million persons were killed and radical peasant and workers' organizations destroyed. Little was done that year to increase the production of food.

By the dry season of 1966, the slaughter had come to an end in most areas. Despite the enormous social dislocations, the government expanded the area planted in rice from 27,000 to 415,000 acres, and this occurred in the first dry season that had ever been made a target of the rice production increase idea.

Dry season planting, however, was not the only innovation. At the invitation of the new military regime, American and West European advisors, most of whom had been thrown out of the country in 1963–64, now returned in large numbers to help put together a new development effort in Indonesia. In June, 1967, the government contracted with CIBA (Chemical Industries of Basel, Switzerland) to have this giant multinational corporation provide the technical apparatus for

Rice stalks are cut down with small knives, tied into bundles, and taken to the landowner's home. As wages, each laborer will receive one-tenth of the rice he harvests.

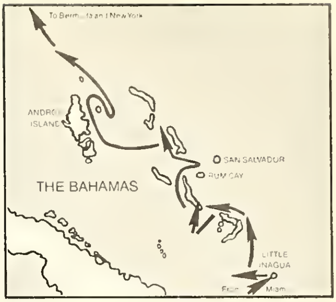
RICHARD W. FRANKE

an experimental project to increase rice production in a small area in south Sulawesi (Celebes), to the northeast of Java.

Although no evaluation of the project was made, contracting with Western corporations continued at a rapid pace. By the rainy season of 1969–70, the West German companies Hoechst and A.H.T., the Japanese Mitsubishi, and a new, unknown company called Coopa were also offering the new agricultural technology, which for the first time included the miracle seeds from Los Banos. Together these companies provided fertilizer, miracle seeds, pesticides, and management advice for 2,470,000 acres, more than 20 percent of the entire wet-rice land of Indonesia.

Even from the start this massive program ran into difficulties. The new pesticides, untried on Indonesian fields, killed not only the harmful rice stem borer and various grasshoppers, as they were intended to do, but also the fish in the irrigation canals, an important source of protein in the peasant diet. One critic of the program asserted privately that one of the German com-

MERIDA
From Bimini
CANCUN ISLAND
UXMAL
TULUM
MEXICO
TIKAL
ISLA DE GUANAJA
CARATASCA
PUERTO BARRIOS
TELA
COPAN
HONDURAS



Western Caribbean and the Inner Space of the Bahamas

—two rare oceanographic expeditions aboard the M/S Lindblad Explorer*

Western Caribbean: This cruising expedition offers a great variety of exciting activities. You will examine ancient Mayan and Aztec archeological sites along the coast of Central America, and explore the reefs and underwater world along its shores. You will visit lagoons, rivers, jungles and off-shore islands seldom seen by tourists. This cruise starts from Fort Lauderdale on May 25.

The Inner Space of the Bahamas: This very special cruising expedition ventures into a truly spectacular underwater world. Here, your own participation is the key to enjoyment. Well-known oceanographers will be on hand and expert divers will assist you in snorkelling and diving among the fascinating coral reefs. Our Zodiac rubber rafts will let you explore colorful fish and floating plant-life among the shallow waters of these islands. The M/S Lindblad Explorer is fully air-conditioned and offers all the comforts of cruising life. It is operated in the famed tradition of the Swedish American Line. This expedition starts from Miami on June 11. Please write for our informative brochure.

LINDBLAD TRAVEL, INC.
Dept. NHAR174
133 East 55th Street, New York, N.Y. 10022
(212) 751-2300

*Panamanian registry

WAYSIDE GARDENS
1974

It's like a long, fascinating walk in a beautiful garden.

Famous Wayside Gardens Catalog

216 pages, packed with 1,900 varieties of trees, shrubs, perennials, roses.

New 1974 Edition, $2.00

- 88 pages of perennials.
- 78 pages of trees, shrubs and fruits.
- 14 pages of roses.
- 19 pages of bulbs and tubers.

Plus many pages of annuals, herbs and vines . . . and dozens of help-to-grow items.

OPENS THE DOOR TO BEAUTIFUL GARDENS.
Hundreds of ideas in beautiful color from one of America's most respected nurseries help you plan and plant the most exciting garden in your neighborhood.

MORE THAN A CATALOG, IT'S A REFERENCE BOOK.
The Wayside Catalog contains clear, accurate descriptions of each item, plus botanical names, colors, sizes, blooming periods, planting tips and much more.

A GUARANTEE THAT MEANS WHAT IT SAYS.
Your order will arrive in good growing condition. And, even if you goof up later (up to 6 months later) through forgetfulness or inexperience, we'll stand half the replacement cost. That's our guarantee!

PLUS AUTUMN CATALOG. NO EXTRA COST.
With the regular catalog, you receive at no additional cost the Autumn Catalog—80 pages of Spring blooming offerings. Reg. $1 value.

WAYSIDE GARDENS 650 Mentor Avenue, Mentor, Ohio 44060
Enclosed is $2.00. Rush my new Wayside Catalog. I understand that my catalog will contain a $2 credit certificate and that my satisfaction is guaranteed.

Name ____________________

Address ____________________

City ____________ State ____________ Zip ____________

LINDBLAD IN ASIA
73 74

TRAVEL THE WORLD OF LINDBLAD

ADVENTURE is the word when you travel with Lindblad through *Incomparable India.*

One of Lindblad's great Asian Safaris

Rudyard Kipling comes to life in Lars-Eric Lindblad's exciting new 24-day tour through ancient India. You will see tigers from elephant back in Kahana and you will be guests of the Royal Family of Jaipur at their lodge. Your camera will be constantly at work while visiting spectacular temples and historic shrines. An excursion on the sacred Ganges will reveal strange religious rites as they were performed thousands of years ago. You will see the snow-capped Himalayas to the north. Across the border you will find the remote kingdom of Sikkim with the world-famous Tibetan Lama Monestary. Write for our "Lindblad in Asia" brochure which also includes these tours: **Himalayan Wildlife, Borderlands of Tibet, Persia & Afghanistan, Malaysian Nature Tour, Japanese Nature Tour and Explorers' Tour to Central Asia & Mongolia.**

LINDBLAD TRAVEL, INC.
Dept. NHA 174 (212) 751-2300
133 East 55th Street, New York, N.Y. 10022

THE AMERICAN MUSEUM
OF NATURAL HISTORY
presents

THE FIELD GEOLOGY OF THE GRAND CANYON

June 3-15, 1974

A 10-day, 300 mile float trip through the Grand Canyon on the Colorado River, biggest and fastest whitewater river in the country. Study of the first 1 and ¾ billion years of Colorado Plateau history. Then, on to scenic Zion and Bryce Canyons nearby to study the remaining 250 million years of this region for the last 3 days. Field leader and lecturer is Christopher J. Schuberth from The American Museum.

For further detailed information, call or write immediately:

DEPARTMENT OF EDUCATION
The American Museum of Natural History
Central Park West at 79th Street
New York, New York 10024

Telephone: (212) 873-7507

panies was spraying onto the fields and into the canals the very chemical that had previously killed millions of fish in the Rhine, but the government never investigated this charge. Above and beyond all the stories and complaints, one fact was evident: farmers were not repaying the loans they had been granted.

Complaints continued. Students reported that in many areas the packages of fertilizers, seeds, and pesticides were not arriving. Then in the latter part of 1969, just about the middle of the 1969–70 planting season, the nature of Coopa, the mysterious corporation, became clear. Reporters for *Indonesia Raya,* a major muckracking newspaper in Jakarta, discovered a company letter dated in Vaduz, Liechtenstein, on the same day as the day of its arrival in Indonesia. Company officials had claimed registration was in Italy, but this was only part of the problem for, as the paper reasoned, "even the most modern airplane in the world cannot carry a letter from Liechtenstein to Indonesia in less than one day." When further evidence came in, the only question remaining was which generals secretly owned the company? At a cost of more than 150 million rupiahs (equal to $400.000 at the time), Coopa failed to deliver the technology for which it had contracted, and when evidence began to link the company's operations with members of President Suharto's personal staff, the President announced that the entire affair would be handled out of court. The development planners' idyllic rate of profit seemed to have become highly elusive.

Scandal ridden as it was, the total program of multinational corporation agriculture rolled on into the dry season of 1970 before the real reaction came. Continuing reports of unsatisfactory harvests were added to stories of inefficiency and corruption. Even in the best agricultural areas, harvests had fallen off from 2½ tons per acre in 1965 to 2 tons per acre in 1968–69; in many regions crops were almost entirely lost because pesticides and fertilizers never arrived. Some government offices reported harvests of as little as from 220 to 882 pounds per acre, and a major famine occurred on the north coast of Java, involving 100,000 persons.

Various international lending institutions, including foreign embassies, commissioned private studies of the program, and all agreed that no matter how perfect it looked on paper, something was not working. That that "something" was intimately related to the destruction of peasant and student political power and the rise of a bureaucratic military state was apparently outside the realm of development theory. The example of the students who once forced the government to deliver fertilizer was lost in the midst of theories that saw political action from below as insignificant, perhaps even threatening, in comparison to the power of technology.

Since the program was failing, something new had to be tried. By the rainy season of 1970–71, American and Indonesian planners launched a new program, incorporating many features of the pre-1965 experiments. First, interest rates on farmer loans were reduced from 3 to 1 percent. Secondly, the program was not packaged: a farmer could choose his own fertilizer and pesticide dosages without endangering his chance of getting seeds or a preharvest cost-of-living loan. Aerial spraying of pesticides, a major source of farmer opposition to the foreign companies program, was discontinued altogether. Finally, to insure that the rate of profit would not be disturbed by price instability, the United States provided surplus rice that could be alternately injected into, or withdrawn from, regional markets. Farmers, it was hoped, would finally begin to see a profit from their harvests. The new plan, however, was doomed to failure by factors at the village level.

Like the national society of which they are a part, Javanese villages are highly stratified, with access to production resources distributed most unequally among different groups. A village along the north coastal plain of central Java illustrates this problem well. Excellent soil, good irrigation, nearby transportation, milling facilities, markets, and a long history of farmer acquaintance with new technology through their experience with the sugar factories should have made this a perfect place for a Green Revolution success story. Most farmers, however, cultivate plots of less than one acre, too small

TRAVEL THE WORLD OF LINDBLAD

BOTSWANA WING SAFARI,

another "first" in Lindblad's world-wide explorations.

There exists a fascinating country in southwest Africa known as Botswana (formerly the Bechuanaland Protectorate). It is perhaps one of the few remaining pockets of unspoiled nature left in this world. All your travel into this verdant nature paradise will be done by sturdy Land Rovers as well as by small planes. You will see sizeable animal herds of all kinds, visit National Parks and, because the Etosha Game Reserve is one of the finest in the world, we have decided to include it on our itinerary. The opportunities for excellent nature and animal photography are endless. Unlike East Africa, people are permitted out of their Land Rovers to photograph the animals. Your nights will be spent in restful and well-managed camps and lodges. And because this twenty-day Botswana Wing Safari is a very popular Safari, we suggest you write at once for our informative color brochure.

LINDBLAD TRAVEL, INC.
Dept. NHS174
133 East 55th Street, New York, N.Y. 10022
(212) 751-2300

"Has the ring of a classic."
—Mel Ellis

Ewan Clarkson
IN THE SHADOW OF THE FALCON

Through the life history of one pair of peregrine falcons and their offspring, the author of *Halic* transports the reader magically into their world of wide, windswept skies and vast northern seas off the coasts of Wales and Scotland.

"Fine, authentic and most appealing.... intensely interesting to anyone with a feeling for ecology or nature."
—*Publishers Weekly*

Drawings by David Stone

dutton $6.95 at booksellers

JEWELRY LIFE SIZE
BC-8 Byzantine Cross
EY-1 Sacred Eye Ring (Ancient Egyptian Doctor's Amulet)
AP-5 ANKH PENDANT 2½" long

Ancient Jewelry Replicas
In 14 Karat Gold & Sterling Silver

		Sterling Silver	14K. Gold
AP-5	Ankh Pendant 24" ch.	$27.00	$89.00
BC-8	Byzantine Cr. 24" ch.	29.50	95.00
EY-1	Sacred Eye Ring	25.00	89.00

Rings sized to 11½ no extra cost. • Money back guarantee. Add $1.50 for insured postage. • Orders shipped promptly. • Bankamericard & M.C. for orders $50. minimum.

XMAS ORDERS SHIPPED IN 48 HOURS!

FREE COLLECTOR'S CATALOG-24 pages picturing over 75 ancient world relics from BC to AO. Plus, catalog featuring over 50 ancient jewelry replicas in precious metals Satisfy your gift needs today.

aladdin house, ltd.
Dept. NJ174 • 648 Ninth Ave. • N.Y. 10036

to support their families. They are forced, therefore, to supplement their farming with outside jobs. Since not enough jobs are available, many of the farming households ought to go bankrupt, but they do not. In the village a group of large landowners, government officers, and town employees command capital for the small farmers. The capital takes the form of loans against the future labor of poor farmers, a form of debt-bondage in which the farmers must give up their option for outside jobs and be permanently on call to their patrons.

The mechanism is simple. During the preharvest period, smallholder families may run out of cash or food. If unable to find work outside the village agricultural economy, they are forced to attach themselves to a wealthy family by asking for a loan. Since they have nothing to offer in repayment—their next harvest will be no more effective in bringing them even a minimum of subsistence (much less a surplus) than was the last—they become permanently indebted, accepting a 30 to 50 percent cut under the market wage for farm labor and giving up the opportunity for future labor arrangements outside the village.

In such a situation, miracle seeds might seem highly beneficial. In addition to improving everyone's production of food, raising the standard of living, releasing the central government from its dependence on food imports, and lowering food prices, the productivity increases of from 50 to 100 percent on local farming plots of smallholders might eventually offer them the opportunity to reassert their independence from the lenders. That, however, is just the problem.

The wealthier families have clearly perceived the danger of too much technical progress of this sort, and during the rainy season of 1970–71 and the dry season of 1971, they used various means of preventing the smallholders from gaining access to the loans or to the technology. In some cases meetings to publicize government loans were never called, but notice of bank loans was passed along lines of kinship and neighborhood, thus kept within the circles of the village elite. In some cases subtle hints were delivered to small farmers; not much is needed to convince a family on the brink of starvation that they are better off with the security of the wealthy patron than striking out on their own even if the chances of success seem to be high. Failure to a family farm is not quite like bankruptcy for a modern business; there are no courts to handle starvation proceedings.

By the end of the dry season in September, 1971, the new technology was being utilized only on about 40 percent of the available paddy land, representing only 20 percent of the 151 households in the village. Poor families were totally absent from the list of participants. For them the promise of economic development meant only an increase in the wealth and lending potential of their patrons, and an opportunity for more of their class compatriots to fall into permanent debt and servitude.

In other parts of Java, the relationship between the social classes has deteriorated beyond the increased debt-labor bondage. In south-central Java, wealthy households are using the increased productivity of their fields to actually buy up paddy land from poorer families, driving the latter into the already jobless urban areas. In west Java, a region where landholding differences are even more extreme, some wealthy farmers have even begun buying Japanese-made ricefield tractors and home milling facilities, thus pushing an even greater number of landless and smallholding households out of the remnants of the rural labor market. The very possibility of technological success is creating a human disaster. For the poor, the Green Revolution in Java offers only the choice between servitude and homelessness.

What will the development theorists say about all this? Their answer lies in their actions: the programs continue as before with no substantial changes. The technology advocates, the rate-of-profit theorists, the military dictators, and the large landowners are attempting to produce enough food for the people of Java. They are failing. Their optimistic plans and programs have created only increased human suffering and promise more of the same. Perhaps solutions will come, not from the development experts, but from the small farmers and landless laborers of Java. □

African

Trade Beads

Genuine African Trading beads beautifully assembled on a neck ring, with a solid amber pendant.
. . . $13.00 postpaid

Museum Shop
The American Museum of Natural History
79th Street and Central Park West
New York, N. Y. 10024

YES. Please send me ________ African Trade Bead neck rings.
I am enclosing ______ Check
______ Money order for $______.

NAME ____________________

ADDRESS ____________________

CITY ____________________

STATE ____________ ZIP ________

Museum members are entitled to a 10% discount.

Now—a priceless opportunity to gain a deeper knowledge of the PEOPLES OF THE EARTH

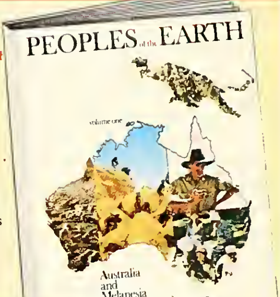
Volume 1 YOURS FREE!

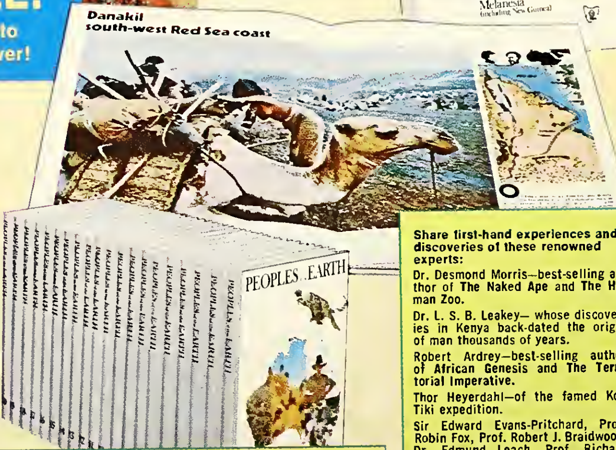
...with no obligation to buy anything, now or ever!

In your free volume . . . meet all the living cultures of Australia, Melanesia, and New Guinea

. . . from the Walbiri aborigines of the sun-ravaged Central Desert . . . to the "Cargo Cults" of Lowland New Guinea . . . from the polygamous Dani Warriors . . . to the sophisticated society of metropolitan Sydney . . . every page an adventure in human understanding!

- More than 120 photographs—over 85 in full color!
- 2-page World Map
- 18 full-color tribal maps
- Measures a big 9" x 11½" with 144 pages!





20 big deluxe volumes!

Thousands of maps and illustrations! Full-color photographs on almost every page. Durable; soil-resistant covers. Completely indexed. Special Volume devoted to "The Future of Man."

Share first-hand experiences and discoveries of these renowned experts:

Dr. Desmond Morris—best-selling author of The Naked Ape and The Human Zoo.

Dr. L. S. B. Leakey— whose discoveries in Kenya back-dated the origin of man thousands of years.

Robert Ardrey—best-selling author of African Genesis and The Territorial Imperative.

Thor Heyerdahl—of the famed Kon Tiki expedition.

Sir Edward Evans-Pritchard, Prof. Robin Fox, Prof. Robert J. Braidwood, Dr. Edmund Leach, Prof. Richard Salisbury, Prof. Jacques Soustelle . . . all consulting editors to PEOPLES OF THE EARTH.

© 1974 Grolier Enterprises Inc.

Introduce your family to the vast and varied family of mankind.

We wish to send you—absolutely free—and with no obligation to buy anything ever, Volume 1 of this exciting new illustrated Library, PEOPLES OF THE EARTH.

This handsome book on *Australia, Melanesia, and New Guinea* is complete in itself. We're offering it to you as a gift so you can see for yourself how beautiful this unique Library is, and why it's being heralded as a major contribution to the field of human sciences.

Each additional Volume will take you on yet another great adventure of discovery, guided by some of the most distinguished scholars and explorers of our day. You'll read about the Faroe Island descendants of the Vikings . . . the Georgians of Russia who live to be over 110 . . . the wild, trance-inducing rites of the Malayan Negritos — and so much more!

PEOPLES OF THE EARTH will make a valuable and lasting contribution to every family who owns it. For the child, it provides a compelling incentive to learn. For the budding anthropologist or sociologist, it offers boundless research information and accurate detail. For *all,* it promises the rich satisfactions of the noblest study of all—Man.

Send now for your free book—without obligation!

Let us send you Volume 1 of this remarkable series—to keep as a gift whether or not you purchase even one additional Volume. We're confident you'll be so delighted that you'll want to become a subscriber and receive additional Volumes of the set each month.

As a Subscriber, you will always have the privilege of examining each new Volume in your home—and if you're not completely satisfied, you may return it *at our expense and owe nothing.* At any time you wish to cancel, just say so, and no more books will be sent. If you want to keep any of these beautiful books—you pay the surprisingly low price of just $3.98 each (plus a small shipping and handling fee).

To send for your *free* Volume, simply fill out and mail the attached order form, or write to Danbury Press, A Division of Grolier Enterprises, Inc., Sherman Turnpike, Danbury, Conn. 06816. Your FREE copy of *Australia, Melanesia, and New Guinea* will be sent to you promptly. Remember, you are not obligated in any way by sending for this magnificent gift Volume—so act now!

A4/POE1

Mail This Coupon Today For Your Free 144-Page Book!

Peoples Of The Earth. Dept. RH
A Service of Grolier Enterprises Inc.
Sherman Turnpike, Danbury, Connecticut 06816

This order form entitles you to receive—as a FREE GIFT—Volume 1 (Australia, Melanesia, and New Guinea) of the 20-volume illustrated Library of PEOPLES OF THE EARTH, with no obligation to buy anything. As a subscriber you will be notified in advance of all future shipments and you may reject any shipment or cancel your subscription simply by notifying us before the shipment date indicated on the invoice accompanying your advance shipment notice. (This procedure is designed to provide time for mail delivery and computer processing.) Also, if not completely delighted with any volume after FREE examination in your home, you may return it at our expense and owe nothing.

If we do not hear from you after you have received your FREE volume, we will send you Volume 2 next month, then Volume 3 the following month, and all of the remaining volumes the month after that. Those volumes you decide to keep will become a permanent part of your home library, and you will be billed for only 1 volume per month until they are paid for at the amazingly low price of only $3.98 per volume plus shipping and handling.

Remember, you are free to cancel at any time after taking as many or as few volumes as you like—even none at all if you choose. The magnificent FIRST VOLUME is yours to keep ABSOLUTELY FREE no matter what you decide.

Name. . . . .

Address. . . . .

City. . . . . State . . . . Zip. . . . .

Signature . . . .

If under 21, please have parent or guardian sign.

96381

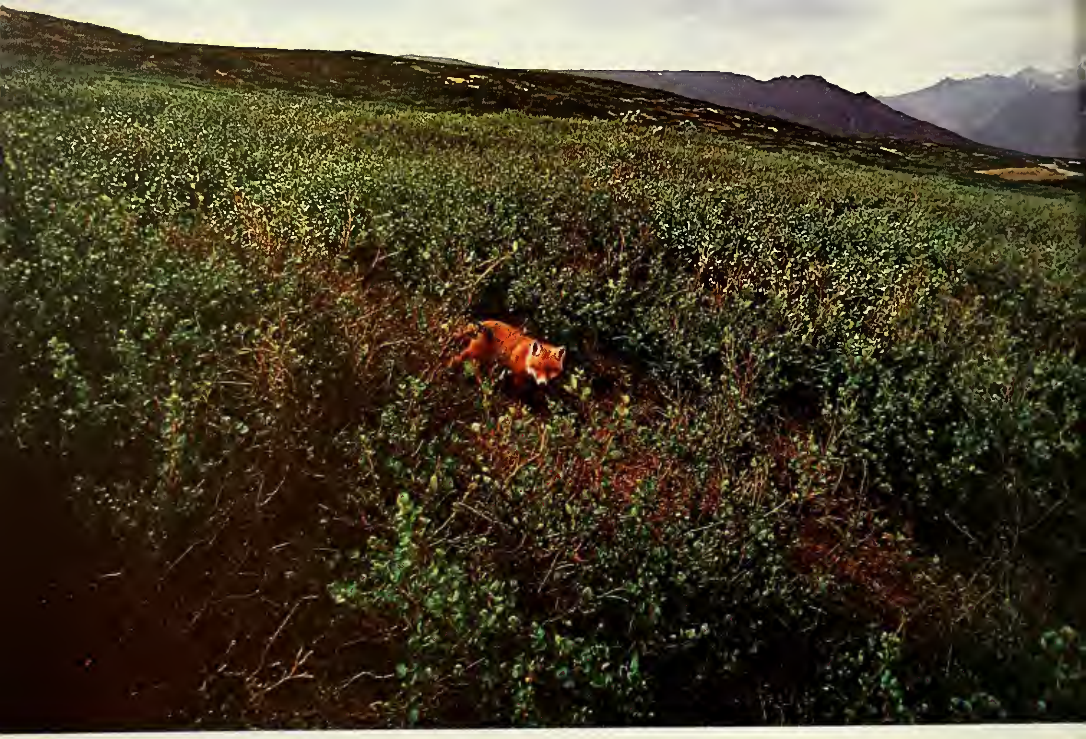
A Faint Image of the Wild World

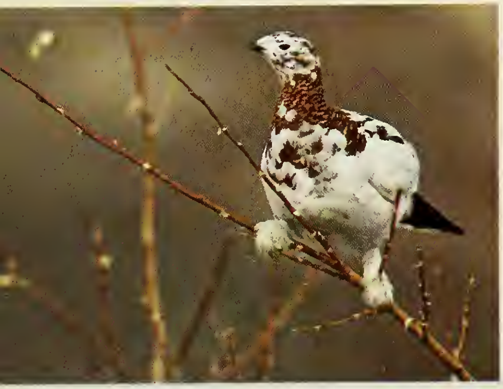
THE WILD PLACES: A PHOTOGRAPHIC CELEBRATION OF UNSPOILED AMERICA. *Harper & Row, $27.50; unpaged; illus.*

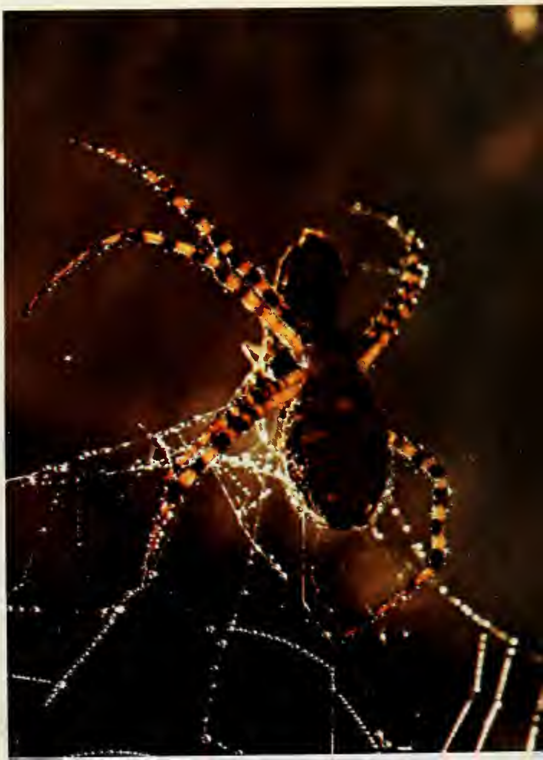
Bringing a sentient part of the outside world into the living room via a picture book is admittedly a tough job; attempting to portray the wild world outside is possibly the most difficult of all. There can be no grandeur of vaulting space, only a miniature picture of it; no vibrations of sunlit color surprising the eye, only printer's ink on the page; no body-bending wind to howl, only words about it. Just to give you a sniff of the wild world takes the best the photographer, writer, designer, printer, and editor can bring together—a fused essence of their various arts.

And so with all the talent and concern that went into *The Wild Places*, it is a shame to see the book turn out the way it did. It seems to be only another victim of the disease afflicting picture books that are produced as holiday gift items for the person who has everything. Even with some redeeming features, the book's poor quality and exalted price could lead any reasonable buyer to choose instead a pair of hiking shoes and seek out a wild place of his own.

The volcanic area of Death Valley, at left, was photographed by David Muench. At right, a photograph of a lobster in a cove near Gloucester, Massachusetts, is the work of Douglas Faulkner.







Dean Brown's picture of a red fox pup in the tundra in Mount McKinley National Park is at top. The photograph of a plump willow ptarmigan hen perched on a bare tree branch, center, is by Charlie Ott. At right, David Cavagnaro's camera has caught a banded garden spider feeding on its prey.

The Wild Places crams the work of some 48 photographers into about 200 pages of "photographic glimpses" of 30 different wild places in the continental United States. This is obviously a no-win game. Many of the photographers have serious statements to make about wild places, but there is no room for that. The authors of the commentary, naturalists Ann and Myron Sutton, come off a little better than the photographers since they have at least the chance to reveal their deep understanding of the wilderness in successive fragments of text that introduce each picture section throughout the book. Even so, as with the photographers, they hardly get started before the prefabricated design of the book interrupts them.

The problem here seems to be with the editorial concept. It simply does not fit the subject. What is on the minds of the publishers does not seem to be what is on the minds of the contributing photographers and writers. Perhaps trying to encompass such a vast and complex subject in such a rapid-fire format is the primary fault. Applying big city, big organization communications techniques to the wild world tends to obscure it, not reveal it. For example a valiant effort was made to print everything including the cover against a black background—an effort, I suppose, to give the book an air of elegance. Instead, it only serves to emphasize the weakness of the inelegant pictures, and there are many. This is especially true of 60 or so double spreads that are the major visual displays in the book. Three-fourths of them are poor in either register, color, picture quality, or layout. That is not a very good record for any picture book. All spreads seem to be printed on a different press from the rest of the book, and their quality is so abominable it approaches disaster. On one spread it is difficult to identify a single wildflower in an entire field of them.

In brief, the editorial concept is inept, the design is unsuitable, and the printing irregular. At best, we are treated to a fleeting kiss of the wild world. At worst, a bad taste.

It is indeed possible to savor those few kisses that *The Wild Places* does offer. Among the photographers are a reasonable number of old faithfuls like David Muench, Bradford Washburn, and Andreas Feininger—who, incidentally, has only one rather sorry back-of-the-file picture although his name is prominently featured in the credits. Elliot Porter's two spreads of a wren and a warbler flying from their nests add a needed vitality to the book, even though the bodies of both birds cross the gutter of the spread and are disfigured by it. Other excellent photographers who were lucky enough to have their work properly, if briefly, presented include Dean Brown, David Cavagnaro, Douglas Faulkner, Charlie Ott, Charles Steinhacker, Kojo Tanaka, and Steven Wilson. Ron Church's pictures probably suffered most by having all five of them packed into two pages, including an underwater ballet of sea lions on the prowl that could have been very revealing if it were big enough to see.

There are, of course, considerations of a larger order than the photographs themselves. We can ask whether the book touches on the real meaning of wild places in our frenetic and artificial world. Are they simply places to take better calendar photographs? Landscapes for publishers to stalk consumers? Does, in fact, the increasing public concern for the environment only lead to an increasing number of commercial predators upon it? Or do the wild places, wherever they still survive, give us a base line for all life on earth, a basic standard for beauty, function, survival? One suspects that the photographers and writers in this book have a sounder understanding of such questions than does the publisher.

So about the best I can do is to return *The Wild Places* humbly, like a good retriever, to the feet of the publisher, even though in his own heart he may prefer a pair of hiking shoes.

Homer Page is a writer-photographer whose work has appeared in museums, books, and magazines both here and abroad. His photographs formed one of the largest individual contributions to the Museum of Modern Art's Family of Man *exhibition. Page has worked as northeast editor of the monthly newsmagazine* Not Man Apart *and is now on an assignment for the Conservation Foundation.* ☐

QUESTAR PHOTOGRAPHS CLAVIUS

This portion of the moon showing the crater Clavius is part of a 35 mm. enlargement which is longer than the telescope that took the picture. It demonstrates the incredible resolution of Questar, the optical giant that weighs only 7 pounds and travels in a leather case less than a cubic foot in size.

There are more than 150 photographs, both astronomical and terrestrial, taken by Questar owners, in the Questar booklet, which describes the world's finest, most versatile telescope. *To obtain your copy, send $1 to cover mailing and handling costs on this continent. By air to South America, $2.50; Europe and North Africa, $3; elsewhere, $3.50.*

QUESTAR

BOX 60M NEW HOPE, PA. 18938

QUESTAR 3½ IN ITS POLAR EQUATORIAL POSITION

LIVE IN THE WORLD OF TOMORROW...TODAY!

A BETTER LIFE STARTS HERE

(And our FREE CATALOG is packed with exciting and unusual ecological & physical science items—plus 4,500 finds for fun, study or profit . . . for every member of the family.)

"FISH" WITH A GIANT MAGNET

Go Treasure Hunting On The Bottom!

Fascinating fun, and sometimes very profitable! Tie a line to our 3½-pound Magnet—drop it overboard in bay, river, lake or ocean. Troll it along the bottom. Your "treasured" haul can be outboard motors, anchors, other metal valuables. Three and one-half-pound Magnet is war surplus—Alnico V Type that cost the Government twice our price. It lifts over 40 pounds on land—much greater weights under water!

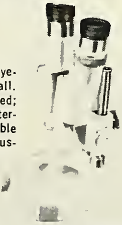
Stock No. 70,570E 3½ lbs.......................$11.50 Ppd.
Stock No. 60215E 1½ lbs..........................$6.50 Ppd.

A CALCULATING TIME-TELLER

Texas Instrument slyly combines a fine 4-function electronic calculator with a precise digital clock. Features instant calculations plus credit balances, a constant floating or preset decimals, chain or mixed calculations in a big 10-digit display. Hours & mins. show on display board until you switch to calculate. Switch back and clock reappears in perfect time—no need to re-set! Our handsome executive-desk calculator is very timely. Great gift!

Stock No. 78,010E..............................$99.95 Ppd.

STEREO MICROSCOPE AT ⅓ PRICE



Mfr.'s surplus! Paired 10x Kellner eyepieces w/rubber eyeguards & paired 3X color corrected objectives for 30X overall. Left side focuses independently. Good definition; collimated; coated optics; long working distance (var. 1½-4"); interpupillary adj: 55-80mm; extends 9-13" overall. Removable diffusing plastic stage; helical rack & pinion for smooth focusing; lockable head swings 360°. Lustra-coated metal, study vibrationless base. 3½ lbs. Imported. Hurry!

Stock No. 71,621E ....$59.50 Ppd.

KNOW YOUR ALPHA FROM THETA!

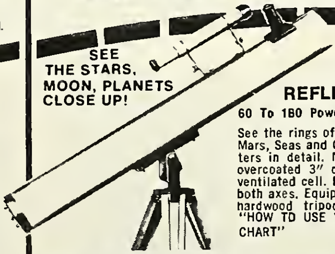
For greater relaxation, concentration, listen to your Alpha-Theta brainwaves. Ultra-sensitive electrode headband slips on/off in seconds—eliminates need for messy creams, etc. Atch'd to amplifier, filters brainwaves, signals beep for ea. Alpha or Theta wave passed. Monitoring button simulates Alpha sound; audio & visual (L.E.D.) feedback. Reliable, easy-to-use unit—comparable to costlier models. Completely safe. Comprehensive instruction booklet.

No. 1635E (8x3x4"; 24 oz.)..............................$128.00 Ppd.
No. 71,809E (LOW COST "STARTER" UNIT)..............................$49.95 Ppd.

GIANT WEATHER BALLOONS—8′ OR 25′ DIAMETER

"Balls of fun" for kids, traffic stoppers for stores, terrific for amateur meteorologists. Create a neighborhood sensation. Great for decorations, launching radio controlled airplanes, scuba diving markers, etc. Amateur meteorologists use to measure cloud heights, wind speed and temperature. Made of thin neoprene designed to burst at high altitudes. Inflate carefully with vacuum cleaner or auto air hose; or locally available helium for high rise.

Stock No. 60,568E (8′ size) ...$ 2.50 Ppd.
Stock No. 60,632E (25′ size)....$13.95 Ppd.



3" ASTRONOMICAL REFLECTING TELESCOPE

60 To 180 Power. Famous Mt. Palomar Type

See the rings of Saturn, the fascinating planet Mars, Seas and Craters of the Moon, Star Clusters in detail. New improved, aluminized and overcoated 3" diameter f/10 primary mirror, ventilated cell. Equatorial mount with locks on both axes. Equipped with 60x finder telescope, hardwood tripod. Included FREE: VALUABLE "HOW TO USE YOUR TELESCOPE" book; "STAR CHART"

DELUXE 3" REFLECTOR TELESCOPE
Stock No. 80,162E..........................$66.50
4¼" REFLECTOR TELESCOPE (45x to 270x)
Stock No. 85,105E..........................$115.00 FOB
4¼" REFLECTOR TELESCOPE WITH CLOCK DRIVE Stock No. 85,107E..........................$149.95 FOB
6" REFLECTOR TELESCOPE Stock No. 85,187E..........................$222.50 FOB
6" REFLECTOR W/(ELECTRIC) CLOCK DRIVE No. 85,086E..........................$259.50 FOB

ORDER TODAY! COMPLETE AND MAIL

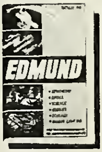
EDMUND SCIENTIFIC CO.
300 Edscorp Building, Barrington, N.J. 08007

How Many	Stock No.	Description	Price Each	Total

PLEASE SEND ☐ **GIANT FREE CATALOG "E"**
MERCHANDISE TOTAL $
ADD HANDLING CHARGE: $1.00 ON ORDERS UNDER $5.00; 50¢ ON ORDERS OVER $5.00
TOTAL $

30 DAY MONEY-BACK GUARANTEE
YOU MUST BE SATISFIED OR RETURN ANY PURCHASE IN 30 DAYS FOR FULL REFUND

NAME ____________________
ADDRESS ____________________
CITY ____________ STATE ________ ZIP ______
I enclose ☐ check
☐ money order for $__________



MAIL COUPON FOR GIANT FREE CATALOG!

180 PAGES • MORE THAN 4,500 UNUSUAL BARGAINS

Completely new '74 Catalog. Packed with huge selection of telescopes, microscopes, binoculars, magnets, magnifiers, prisms, photo components, ecology and Unique Lighting items, parts, kits, accesories — many hard-to-get surplus bargains. 100's of charts, illustrations. For hobbyists, experimenters, schools, industry.

EDMUND SCIENTIFIC CO.
300 Edscorp Building, Barrington, N. J. 08007
Please rush Free Giant Catalog "E"

Name____________________
Address____________________
City__________State__________Zip__________

Suggested Additional Reading

MIRACLE SEEDS AND SHATTERED DREAMS

Seeds of Change. L.G. Brown. Praeger Publishers, Inc., New York, 1970.

Agricultural Involution. C. C. Geertz. University of California Press, Berkeley, 1963.

The Hungry Future. R. Dumont and B. Rosier. Praeger Publishers, Inc., New York, 1969.

SOLVING THE MOON'S RIDDLES

Moons and Planets. W. K. Hartmann. Bogden and Quigley, Belmont, 1972.

Geology of the Moon. T. A. Mutch. Princeton University Press, Princeton, 1970.

Moon Rocks and Minerals. A. A. Levinson and S. R. Taylor. Pergamon Press, Inc., Elmsford, 1971.

A BANQUET FOR THE BIRDS

The Hungry Bird Book. R. Arbib and T. Soper. Taplinger Publishing Company, Inc., New York, 1972.

Song Birds in Your Garden. J. K. Terres. Thomas Y. Crowell Company, New York, 1968.

How to Attract, House, and Feed Birds. W. E. Schutz. The Bruce Publishing Company, St. Paul, 1970.

THE STARVING ROOTS OF POPULATION GROWTH

The Hungry Nations. W. Paddock and P. Paddock. Little, Brown and Company, Boston, 1964.

Population and Society. D. Wrong. Random House, Inc., New York, 1967.

Nutrition and Infection Field Study in Guatemalan Villages, 1959–1964. N. S. Scrimshaw et al. *Archives of Environmental Health*, Vol. 14, page 787, 1967.

TRIAL BY FIRE

Aspects of Religion in South Asia. E. B. Harper, ed. *The Journal of Asian Studies*, Vol. 23, June, 1964, supplement.

Myths and Symbols in Indian Art and Civilization. H. Zimmer. Princeton University Press, Princeton, 1971.

TENTS AND TACTICS OF CATERPILLARS

The World of an Insect. R. Chauvin. McGraw-Hill Book Company, New York, 1967.

Bees: Their Vision, Chemical Senses, and Language. Revised edition. K. von Frisch. Cornell University Press, Ithaca, 1971.

The Life of Insects. V. B. Wigglesworth. The New American Library, Inc., New York, 1968.

FISH ARE WHAT THEY EAT

Ichthyology. K. F. Lagler, J. E. Bardach, and R. R. Miller. John Wiley & Sons, Inc., New York, 1962.

Marine Food Chains. J. H. Steele, ed. Hafner Press, New York, 1973.

WHEN YOU WRITE TO NATURAL HISTORY MAGAZINE

Cut your old address label from magazine wrapper and attach over this area.
Fill in your NEW address below and mail to:
Natural History Magazine
Membership Services Box 6000
Des Moines, Iowa 50306

H001

☐ 1 year—$8 ☐ 2 years—$15 ☐ 3 years—$21
(Add $2 per year to Canada and other non-U.S. orders)

PLEASE PRINT

Name ______________________________

New Address ______________________________

City ______________ State ________ Zip ________

about a change of address, renewal of subscription, billing, or any kind of adjustment, send the present address label from the magazine wrapper.

Moving? Please notify 6 weeks in advance.
You can use this form to tell us about a move or order a subscription.

Change of address—attach your address label in the dotted area and fill in your new address at left, clip and mail to: Natural History Magazine, Membership Services, Box 6000, Des Moines, Iowa 50306.

A new subscription—Check box and fill in name and address at left.

oneness

A subtle linking of
man's religious symbols,
delicately wedded
together by the artisan.

14K with 24" chain $35.00
Sterling Silver $16.75

ISAAC SOLTES DESIGN NH
1923 S. McPherrin Ave.
Monterey Park, Calif. 91754
Check or Money Order / Money-back Guarantee

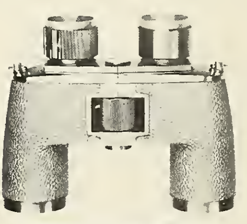
16th INTN'L ORNITHOLOGICAL CONGRESS
Canberra, Australia, Aug. 12-17, 1974

Group flights, also stopping at Fiji and New Zealand. Seven birding optional tours available. With land arrangements per itinerary, from San Francisco.

Aug. 1-28 **OR** Aug. 1-Sept. 4

WOODMERE TRAVEL, 952 Broadway, Woodmere, N.Y. 11598

SHELLS, MINERALS, FOSSILS, INDIAN ARTIFACTS
Send 50¢ for Illustrated Catalog
DOVER SCIENTIFIC
Box 6011 C Long Island City, N.Y. 11106



BUSHNELL 7x35 CUSTOM
Regular $125.50 Postpaid $79.50

This is an example of the deep discount prices on high quality optics that is found in our FREE catalog. This catalog lists and illustrates an outstanding selection of camera lens, telephoto lens, telescopes, binoculars etc., plus valuable information on how to properly select them. Write for it today.

GIL HEBARD OPTICS
COURTHOUSE SQ., KNOXVILLE, ILL. 61448

£125,000 ($300,000) and 2 years of loving labour went into this sumptuous Centennial Edition of

THE COMPLETE WORKS OF DICKENS

As your introduction let us send you

FREE

Great Expectations

WITHOUT ANY PURCHASE OBLIGATION WHATSOEVER

BOUND IN EUROPE IN OLD WORLD STYLE

The quality of printing and binding in this Centennial Edition is seldom seen in the U.S.A. The covers have the look and feel of a kid glove. Their delicate design is 24 kt. gold. The books are full of gracious touches you have not seen in years: decorated endpapers, silk headbands, sewn-in bookmarks, period illustrations. A perfect expression of good taste in decorating as well as in literature.

Now . . . let these unforgettable characters of the world's master story-teller walk into your home.

Let this be your introduction to the most fascinating characters that any writer's genius ever created. The improvident Micawber, always waiting for something to turn up . . . Uriah Heep, the "so very 'umble" . . . honest Pegotty endlessly roaming in search of his seduced daughter . . . Sampson and Sarah Brass . . . Quilp . . . and poor little Nell . . . their very names breathe the magic gift of Charles Dickens for creating vivid characters. Every page you read comes alive with real people whom you'll love . . . hate . . . pity . . . and never forget! *Now meet them—treasure them in your home—in beautiful books worthy of the genius who created them.*

Rich heirloom bindings—classic illustrations

This sumptuous Centennial Edition of the Works of Charles Dickens took Heron Books in England £125,000 and 2 years of loving effort to create. The edition has taken British booklovers by storm, and is now available here at amazingly low cost. With classic-style printing, elegant gold-tooled rich-textured bindings, and the original illustrations of such famous Dickens artists as Cruikshank, "Phiz" and Tenniel, these books are treasures indeed. They will beautify your bookshelves, enrich your home, and delight you, your children, and generations to come—just as their tales have delighted generations past.

But you have to see them, take them in your hands, examine them lovingly to recognize their full value. We therefore make this fantastic offer: Accept as an outright gift one of the best loved Dickens classics *"Great Expectations"* . . . FREE! Simply mail the Free Dickens Coupon and discover the superb Centennial Edition without obligation to buy a single book!

Your opportunity to build a beautiful library —at low cost

If you are not absolutely convinced after reading and examining your first volume that the Centennial Edition represents a publishing venture of such unique beauty that you will always be proud to have such books in your home, then simply notify us within 10 days and your subscription will be cancelled without your having bought a single volume. And GREAT EXPECTATIONS will still be yours to keep.

But if you are as thrilled by the beautiful and elegant binding, as charmed by the many reproductions of the original illustrations, and as fascinated by the masterful Dickens narrative as we think you will be, then each month thereafter we will advise you in advance of every shipment, which you may accept if you wish at the special low subscriber price of $3.89 plus shipping. Each book will be identically printed and bound in Europe to the same high standards. But you will not have to take more than you actually want. You may terminate your subscription any time you decide your collection is as complete as you want it.

Limited Edition—reserve now. Clearly, an edition of this magnificence cannot be produced *en masse*. Our import quota is limited. Should it be over-subscribed, it may take some time before additional sets can be offered. To avoid disappointment, send the Free Reservation Coupon now.

HERON BOOKS, 201 Lincoln Blvd., Middlesex, New Jersey 08846

Free Reservation Coupon:

HERON BOOKS, 201 Lincoln Blvd.,
Middlesex, New Jersey 08846

Please send me as an OUTRIGHT GIFT the sumptuous Centennial Edition of *Great Expectations*. Accepting this gift does not obligate me to order any further books, not even one!

You will send me advance notice of all matching Dickens Centennial Edition volumes as they become available, and I may reject any shipment merely by notifying you. I may return any volume you send without penalty after a 10-day free examination, or I may keep it for just $3.89 plus shipping.

You will cancel my subscription whenever I notify you I consider my collection complete. There is no minimum number of books I must order—*not even one! Great Expectations* is mine to keep FREE in any case.

Signature________________

Print Name________________

Address________________

D-213

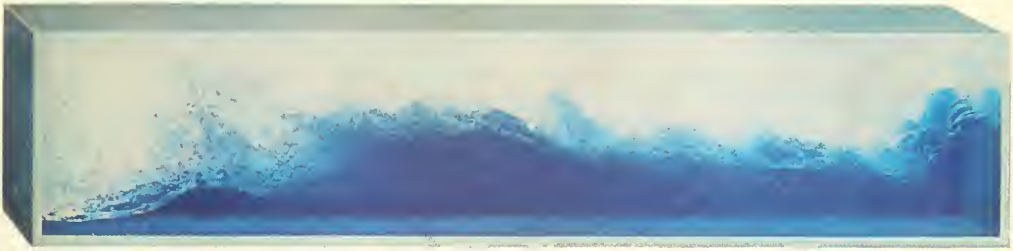
City________________

State________ Zip________

FOR CANADA: Return coupon to us. Special arrangements for servicing Canadian subscribers have been made.

D11

artist: peter chermayeff



The ideal
Seas that are permanently protected from man's abuse.

The real
Thoughtlessly, man spews waste into the world's oceans. From the air, from the streams, from ships, all of it from ourselves.

We must find new and better ways to guard our waters from ourselves. Our solutions must be swift. They must be creative and mature. For tomorrow the waters of the world will inherit what we do today.

Throughout the world, man must learn to function without fouling the oceans—and the air and earth that adjoin them. Until then, we cannot protect the environment in which life began—and on which our lives still depend.

AtlanticRichfieldCompany

magnum: erich hartmann

(Advertisement)

"The well-managed forest benefits the environment. You can see it happening right here."

John Preston

Director of the Museum of Science and History, Little Rock, Arkansas.

John R. Preston is an ardent conservationist involved in environmental education. Recently, Mr. Preston had this to say about the Southern Forest: "Like many environmentalists, I used to question the idea that a managed forest could be used for anything but timber production. But the well-managed forests of the South have convinced me that this is not necessarily the case. It is apparent that well-manged timber stands provide a number of priceless benefits including ground cover, watershed, renewable timber resources, wildlife habitat, and a variety of recreational opportunities. The results of multiple-use forestry, as practiced in the Southern Forest for the past thirty years, have pretty much convinced me that the environmentalists and the forest industry are not as far apart as many people think."

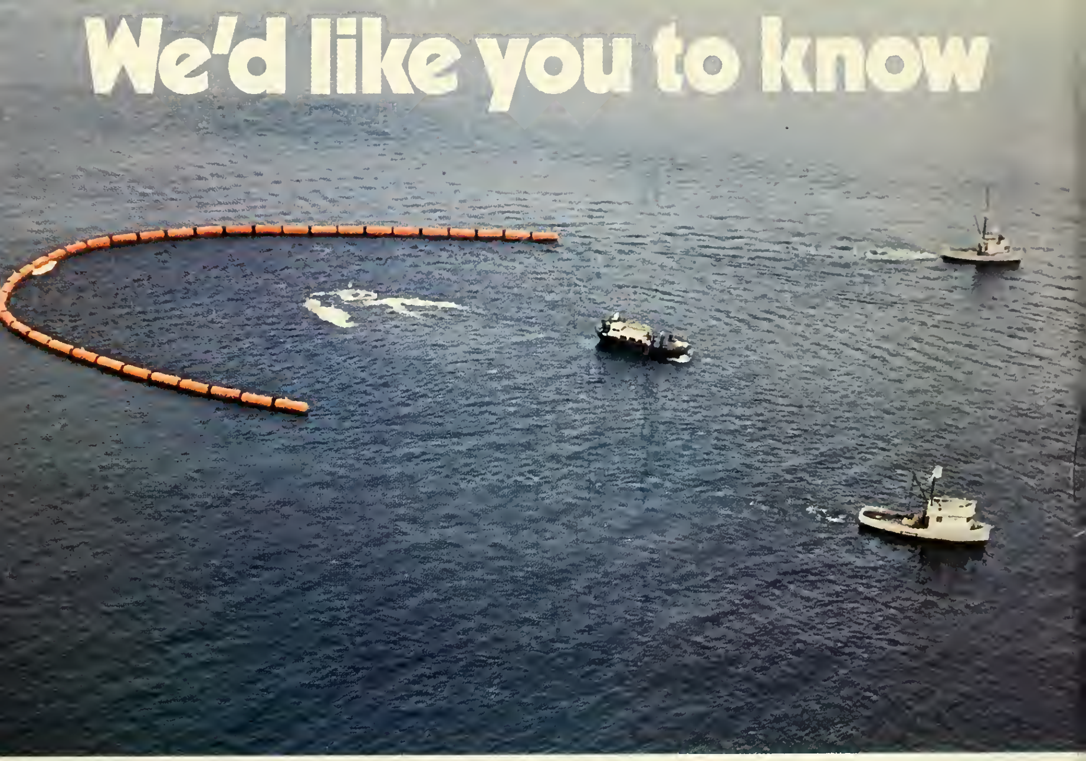
Through multiple-use forestry, the forest industry is seeking and reaching many of the goals of the environmentalists.

For more information, write to Southern Forest Products Association, P. O. Box 52468, New Orleans, Louisiana 70152.

NATURAL HISTORY

FEBRUARY 1974 • $1

We'd like you to know



How Exxon's new floating fence corrals oil spills.

Containing an oil spill in calm water is no great trick. The tricky part is containing it in rough water. And we're pretty sure that Exxon has developed a device that can be used in rough water.

It's called a Bottom-Tension Boom. It's actually a floating fence that is pulled around an oil slick by tugboats. The fence hangs from a thousand-foot boom of flotation units.

What makes the bottom-tension boom unique is that the tow lines are attached only below the water line. This keeps the underwater fence taut so oil can't escape under or over the boom. The unit is pulled around a spill and the oil is then pumped into a floating barge nearby.

As safe as offshore drilling and tanker operations are, there is always the possibility of a spill. But tests have shown that the bottom-tension boom works. Works so well, in fact, that we've decided to offer royalty-free licenses under any patents we may obtain on it.

EXXON

NATURAL HISTORY

Incorporating Nature Magazine
Vol. LXXXIII, No. 2
February 1974

The American Museum of Natural History
Gardner D. Stout, President
Thomas D. Nicholson, Director

2 Authors

4 Letters

10 This View of Life: Sizing Up Human Intelligence
Stephen Jay Gould
Are we as smart as we think we are?

16 A Naturalist at Large: The End of the Energy Orgy
Kenneth E. F. Watt
After some indigestion, Americans may find themselves in a golden age.

24 The Northernmost People
Fred Bruemmer
If all other humans vanished, this small group of Eskimo could live on happily.

34 New Zealand's Mountains: A Majestic Accident
Christopher H. Scholz
When parts of the earth's shifting crust met, these awesome peaks rose.

43 Oscar: An Inquiry into Madness
Peter J. Wilson
This odd man was scorned and feared . . . and strangely important to the people of Providencia.

52 Life-giving Oils in the Strait of Georgia
Ritchie R. Ward
When the links of a marine food chain are fully understood, humans may benefit greatly.

62 The Programmed Extinction of the Sandhill Crane
Richard S. Miller
Unless we change our behavior toward it, this ancient bird will rapidly disappear.

72 Bios: The Blind Staggers
Arthur W. Galston
A rare element helps the growth of certain plants, but plays havoc with herbivores.

76 Celestial Events
Thomas D. Nicholson

78 "Scaly things that shuffle and lurk . . ."
A review by John H. Heminway, Jr.
Should conservationists concern themselves with a hard-skinned, loathsome man-eater?

90 Additional Reading

92 Announcements

Cover: *Standing by a nest built of grass and reeds, a long-legged sandhill crane tends its clutch of two eggs. These birds are becoming increasingly rare, and only four isolated races remain. Photograph by Kenneth Fink, National Audubon Society. Story on page 62.*

Alan Ternes, Editor
Thomas Page, Designer
Board of Editors:
Sally Lindsay, Frederick Hartmann,
Christopher Hallowell, Toni Gerber
Carol Breslin, Book Reviews Editor
Florence G. Edelstein, Copy Chief
Karen Bierstedt, Copy Editor
Angela Soccodato, Art Asst.
Diane Pierson, Editorial Asst.
Lillian Gindea
Joyce E. Klutch

Rosamond W. Dana, Publications Editor

Editorial Advisers:
Dean Amadon, Dorothy E. Bliss,
Mark Chartrand, Niles Eldredge,
Vincent Manson, Margaret Mead,
Thomas D. Nicholson, Gerard Piel,
Richard G. Van Gelder

David D. Ryus, Publisher
L. Thomas Kelly, Business Manager
Ernestine Weindorf, Administrative Asst.

Robert E. Williamson, Production Manager

Ann Brown, Circulation Manager
Dinah Lowell, Assistant Manager
Joan Mahoney
Harriet Walsh

Harvey Oshinsky, Advertising Sales Manager
Gordon Finley
Harry R. Jeter
Vic Asselin
Eileen O'Keefe, Production

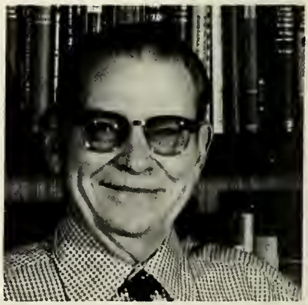
Publication Office: The American Museum of Natural History, Central Park West at 79th Street, New York, N.Y. 10024. Published monthly, October through May; bimonthly June to September. Subscriptions: $8.00 a year. In Canada and all other countries: $10.00 a year. Single copies $1.00. Second-class postage paid at New York, N.Y., and at additional offices. *Copyright © 1974 by The American Museum of Natural History. No part of this periodical may be reproduced without the written consent of* Natural History. *Manuscripts and illustrations submitted to the editorial office will be handled with all possible care, but we cannot assume responsibility for their safety. The opinions expressed by authors are their own and do not necessarily reflect the policy of The American Museum.* Natural History *incorporating* Nature Magazine *is indexed in* Reader's Guide to Periodical Literature.

Authors

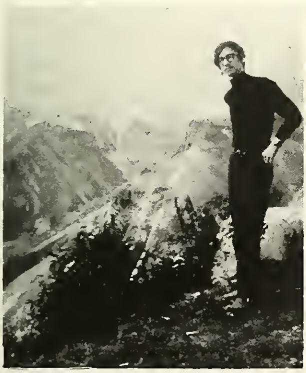
"Sizing Up Human Intelligence" is the second in a series of columns that **Stephen Jay Gould** will be writing for *Natural History* under the general title: "This View of Life": a title taken from the last line of Darwin's *Origin of Species.* It reflects Gould's evolutionist perspective on all sorts of organisms and events. An associate professor of geology at Harvard University's Museum of Comparative Zoology, Gould does field work in the Bahamas and Bermuda and relaxes by singing in choral groups.

"To remind myself that I am a zoologist," writes **Kenneth E.F. Watt**, "I do field work every summer, mostly in coral reefs or rain forests." The rest of the time, Watt, who is professor of zoology at the University of California at Davis, studies the relation between the spatial design of cities and per capita energy consumption and develops global computer simulation models. His examination of early nineteenth-century resource consumption rates led to his interest in placing today's energy crisis in historical perspective.

Earthquakes have been a part of **Christopher Scholz's** life since he was a boy in California, where, he says, "I always had a feeling of excitement mixed with awe when I felt an earthquake." After doing seismological field work along California's San Andreas fault, Scholz went to New Zealand, where his research on that country's Alpine fault led to further investigations on the origins of the Southern Alps. He is now teaching geology at Columbia University and doing research on earthquake prediction at the university's Lamont-Doherty Geological Observatory.



For the past ten years, writer-photographer **Fred Bruemmer** has spent about six months of each year traveling through the Arctic. His expeditions have ranged from Alaska to the Thule district of Greenland, where he recorded the changing life-style of the world's northernmost people, the Polar Eskimo. A frequent contributor to *Natural History*, Bruemmer has written several books on the animals and peoples of the north; the most recent, *Encounters with Arctic Animals*, was published by McGraw-Hill in 1972.

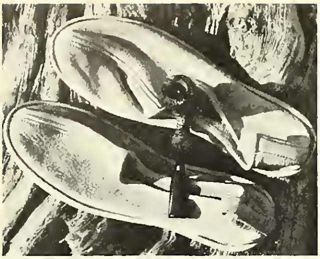


A professional writer with a background in chemistry, **Ritchie R. Ward** has written extensively on the achievements and contributions of prominent scientists. A long-time resident of California, Ward spent five years in Hawaii as a soil chemist, and thirty years as an industrial chemist with Shell Oil, where he was also in charge of the company's information program. Ward is the author of *Practical Technical Writing* and *The Living Clocks*, a book on biological rhythms.

Immediately upon his arrival in Providencia, in 1958, British-born anthropologist **Peter J. Wilson** met Oscar, the subject of his study *An Inquiry into the Nature of Sanity*. He was at once attracted to the man, seeing in him "what passes unnoticed, although not unsuffered, in the lives of ordinary people," and during three field trips to the remote Caribbean island, he spent hours recording Oscar's lengthy monologues. Wilson's broader study of Providencia, *Crab Antics*, was published by Yale University Press in 1973. He is associate professor of anthropology at the University of Otago in New Zealand.

Ademola Olugebefola, who did the illustrations for "Oscar," was born in the Virgin Islands. He has studied at several New York institutes, among them the Weusi Academy of Arts and Studies, where he received a doctorate in 1969. Olugebefola, whose work is in representative collections of Caribbean and Afro-American art, has participated in numerous group exhibitions and has had several one-man shows.

Believing that we must identify the weaknesses in our traditional approaches to wildlife management before we can adequately protect endangered species, **Richard S. Miller** has been using a computer to develop population models of sandhill cranes. Miller has studied these birds on the lakes and grain fields of the western prairies since the late 1950s, when he was teaching at the University of Saskatchewan. Now Oastler Professor of Wildlife Ecology in the School of Forestry and Environmental Studies at Yale University, Miller is also president-elect of the Ecological Society of America. □



A lasting testimony to the word "comfort".

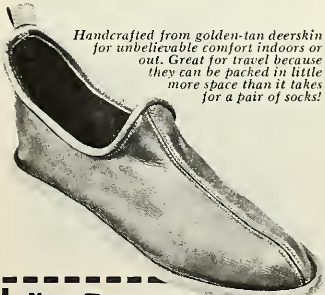
Leather so soft it's hard to describe!

In over 20 years of selling Deer Mocs to our customers, we've yet to discover a way of putting into words the comfort and honest pleasure you'll experience while wearing them. All you feel is the velvet-like softness of the deerskin gently molding itself to the shape of your foot.

Lightweight and cushioned with foam.

Sewn between the sole and innersole is a layer of polyurethane foam that cushions each step and protects your feet from chilly floors. Deer Mocs are extremely light, (about 7 ozs. an average pair) so you feel no sensation of lifting anything but your feet. Deer Mocs . . . soft, supple, and backed with an uncompromising guarantee of satisfaction.

Men's: medium width; 6-12, 13 & 14. Women's: medium width; 4-11 . . . . . .$15.00 ppd.



Handcrafted from golden-tan deerskin for unbelievable comfort indoors or out. Great for travel because they can be packed in little more space than it takes for a pair of socks!

Norm Thompson Dept. NH-F

1805 N.W. Thurman • Portland, Or. 97209
Telephone orders any time: (503) 221-0380

Deer Mocs	Quantity	Size
Men's		
Women's		

☐ Check enclosed. Charge to my ☐ BankAmericard. ☐ Master Charge. (Please include all raised letters and numbers on credit card.)

Card #__________

Signature X__________

Escape from the ordinary

☐ **Send FREE 80 pg. color catalog** Save on exclusive fashions for men & women, fine sportswear & equipment, and articles for your home.

Name__________

Address__________

City__________

State__________Zip__________

Letters

Sharp-toothed Iowans

My immediate reaction to Paul Shepard's inane comment, quoted by C. Loring Brace in "Back to the Bow and Arrow" [November, 1973], that "Iowa is one of the most mismanaged lands in the world," was a hot-headed urge to defend sullied honor. On second thought, I realized that any agricultural system that expends 10 BTUs of primarily petroleum energy to produce a single BTU of vegetable food energy does rather leave something to be desired.

Considering the present state of world oil reserves, Shepard's venatorial utopia may be imminent. The resulting crunch by four billion human beings on limited hunting grounds could be alleviated by stalking the most sacred game of all—man. But I would advise the ensuing tintinnabulation of Terrans to run to ground in Missouri or Illinois. We Iowans are quick as weasels, and have sharp teeth.

David C. Oshel
Ames, Iowa

Happy Hunters

I found it hard to believe the photograph in the December issue of *Natural History* of the hunters with ten geese! Even if the boy did hunt, that is more than three geese each. That is appalling, and the rogues look so darned pleased with themselves, thereby adding insult to injury.

Mrs. Edward H. Miller
Rexford, New York

Forests vs. Tree Farms

The Potlatch Corporation advertisement in recent issues of *Natural History* is correct in pointing out that wood is a renewable resource and that Potlatch and similar corporations can be considered farmers. I believe, however, that the use of the word "forest" is incorrect and misleading. A forest is a complex combination of trees of many species and many ages, shrubs, herbs, and a variety of animal life. To continue the analogy used by Potlatch Corporation, trees can be a crop as corn can, but a tree farm is no more a forest than a cornfield is a prairie.

I believe that everyone's understanding of forestry, logging, and industries such as Potlatch Corporation will be clearer if tree crops are viewed in their proper aspect, as crops and *not* as forests.

Roger A. Powell
Watersmeet, Michigan

The Feeding of Wildlife

A letter in your November, 1973, issue by F. Reed Hainsworth on the feeding of hummingbirds brought to mind how very difficult it is to get simple, believable information on wildlife. Unfortunately, Mr. Hainsworth has not yet satisfied my curiosity about artificial feeding of hummingbirds.

One of the great mistakes of mankind is to seek the feeling of the humanitarian in dealing with animals. Eric J. Alava, writing for *Northwest,* tells about making friends with a great wolf eel off the Oregon coast. He and his friends were able to entice this creature from its hiding place among the rocks to receive food from them whenever they went diving. The result was that a "sport" fisherman found this normally elusive individual swimming toward him for a handout and made an easy kill—to no purpose whatsoever. The eel had learned to trust man—a very poor lesson to teach any animal.

Over a period of time I made my presence comfortable to a pair of wary kit fox in the lower San Joaquin Valley, California, by appearing on daily walks, sitting down on a hill opposite their den, and watching them and their two pups. Little by little they became accustomed to me and felt quite at ease in their daily activities. Then, after two weeks of absence, I returned to find both adults shot with a .22, and the pups dead from starvation.

As far as hummingbirds are concerned, I have thoroughly enjoyed their company in our yard, where there were numerous flowers and a feeder or two to keep them around. So, out of curiosity, I set up a feeder during our month's stay in the mountains at 5,400 feet elevation. The bird that first discovered

Vistafjord✦Sagafjord Cruises. Most people take two.

More than 50% of the passengers who cruise on our two beautiful ships have sailed with us before. And they just couldn't wait to get back to the welcome that's unique to Norway's most experienced world cruise line.

You find it in the service, the cuisine, and in the ships themselves, from your gracious cabin to our dramatic picture-window lounges. You find it in the ports of call, carefully chosen to bring out the best in cruising. And in the warm welcome-back you get when you return from a day ashore.

Where will you cruise with us this year, again or for the first time? It could be the Caribbean or the Mediterranean in spring. Or the glittering North Cape. Eastern Europe, or the South Pacific. Or, in early '75, the Orient or Africa...

So ask your travel agent soon where the Vistafjord and Sagafjord are going. Or call us for brochures. We'd like to welcome you aboard on one of our cruises or two.

CRUISE HIGHLIGHTS 1974-75

From New York (Port Everglades*)
SPRING MEDITERRANEAN, GREEK ISLANDS, April 6*/10. 40 days. 20 ports. Vistafjord.
EASTER WEST INDIES, April 12. 14 days. 7 ports. Sagafjord.
SPRING CRUISE TO EUROPE & BRITISH ISLES, April 26. 35 days. 20 ports. Sagafjord.
NORTH CAPE & FJORDLANDS, June 1. 32 days. 12 ports. Sagajford.
NORTH CAPE & NORTHERN EUROPE, June 25. 42 days. 19 ports. Vistafjord.
SCANDINAVIA AND EASTERN EUROPE, Aug. 7. 30 days. 8 ports. Vistafjord.
FALL MEDITERRANEAN, Sept. 7. 39 days. 15 ports. Vistafjord.
SPANISH MAIN (N. Y. to California), Sept. 14. 16 days. 6 ports. Sagafjord.
SOUTH PACIFIC/AUSTRALIA & NEW ZEALAND, Oct. 1. (from San Francisco) 50 days. 20 ports. Sagafjord.
SIX CARIBBEAN CRUISES, Oct. 19*—Dec. 18*, 10-17 days. 5-10 ports. Vistafjord.
SOUTH SEAS—EAST INDIES—ORIENT, Jan. 7/10*. 90 days. 22 ports. Vistafjord.
FOUR CONTINENTS, Jan. 21/23*. 79 days. 29 ports. Sagafjord.

Vistafjord & Sagafjord, the welcome-back ships.

Norwegian
America
Line

29 BROADWAY, NEW YORK, N. Y. 10006
Tel. (212) 944-6900.

The Vistafjord and Sagafjord are registered in Norway

A small, extraordinary planet...

TIME
LIFE
BOOKS

Start with an amazing universe

. . . that gave birth to an extraordinary planet

. . . that was able to produce 350,000 different kinds of plants

. . . and one million different kinds of animals

. . . that live and die, struggle and adapt, and all the while depend on each other for survival.

The LIFE NATURE LIBRARY

invites you to explore

THE SEA

where life itself began

yours for 10 days free

NATURE LIBRARY
THE SEA
YOURS FREE FOR 10 DAYS
LIFE NATURE LIBRARY
LIFE NATURE

TIME LIFE BOOKS

TIME-LIFE BOOKS Dept. **1004**
Time & Life Building, Chicago, Ill. 60611

Yes, I would like to examine *The Sea*. Please send it to me for 10 days' free examination and enter my subscription to the LIFE NATURE LIBRARY. If I decide to keep *The Sea*, I will pay $4.95 ($5.95 in Canada) plus shipping and handling. I then will receive future volumes in the LIFE NATURE LIBRARY series, shipped a volume at a time approximately every other month. Each is $4.95 ($5.95 in Canada) plus shipping and handling and comes on a 10-day free-examination basis. There is no minimum number of books that I must buy, and I may cancel my subscription at any time simply by notifying you.

If I do not choose to keep *The Sea*, I will return the book within 10 days, my subscription for future volumes will be canceled and I will not be under any further obligation.

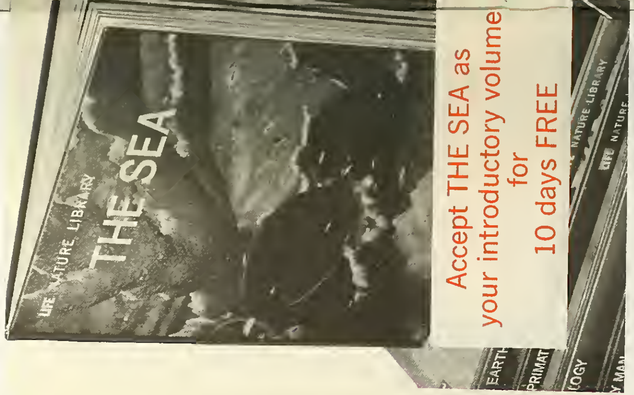
NAME please print

ADDRESS

CITY STATE ZIP

Canadian Residents: Please mail this form in envelope.
Schools and Libraries: Order Library Style Bindings from Silver Burdett Co., Morristown, N.J. 07960. Eligible for Titles I, II funds.

SEND NO MONEY MAIL THIS CARD.


LIFE NATURE LIBRARY
THE SEA
Accept THE SEA as
your introductory volume
for
10 days FREE
EARTH
PRIMAT
LOGY
NATURE LIBRARY
LIFE NATURE

FIRST CLASS
PERMIT NO. 22
CHICAGO, ILL.

BUSINESS REPLY MAIL
NO POSTAGE STAMP NECESSARY IF MAILED IN UNITED STATES

POSTAGE WILL BE PAID BY

TIME-LIFE BOOKS
Time & Life Building
Chicago, Illinois 60611

brimming with life in unimaginable variety...

LIFE NATURE LIBRARY
THE UNIVERSE
THE EARTH
THE POLES
THE DESERT
THE SEA
THE FISHES
THE REPTILES
THE INSECTS
THE MAMMALS

This is the universe . . . perhaps some 10 billion light-years wide . . . where comets fly, supernovae explode, galaxies are born and die . . .

. . . and this is a tiny speck of it, the planet we call earth . . . a strange, wonderful, and improbable world . . .

. . . so cold in spots the temperature plunges to —140° and the icesheet is 9,200 feet thick . . . so warm in others the temperature has reached 136° in the shade . . .

. . . and where nature decided that, despite the cold, despite the heat, despite everything, life was going to win out in a million ways . . . life that probably originated here in the sea . . .

. . . where it flourishes today even at depths of six miles . . .

. . . life that moved onto the land . . .

and always changing, experimenting, reaching...

LIFE NATURE LIBRARY
THE BIRDS
THE PLANTS
THE FOREST
ECOLOGY
EVOLUTION
ANIMAL BEHAVIOR
EARLY MAN

. . . and took wing . . .

. . . all depending on (and making possible) a variety of vegetation from tiny flowers to massive redwoods . . .

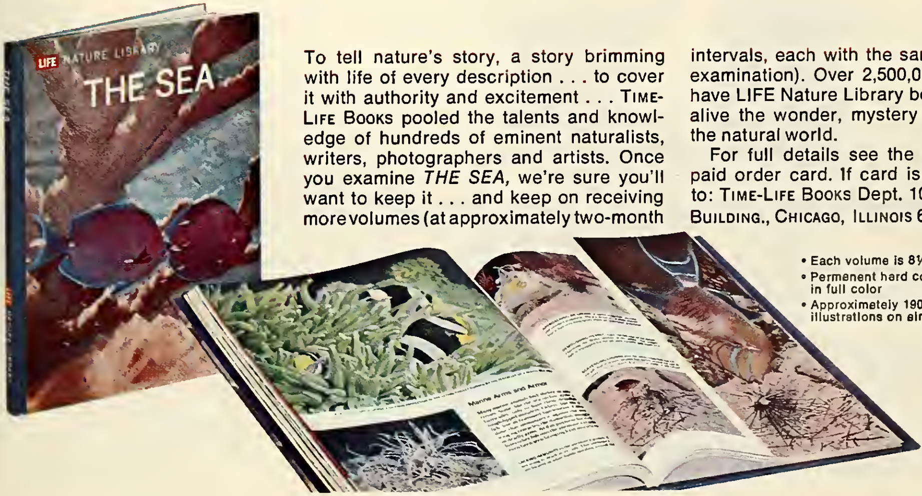
. . . existing in an intricate chain that relates every living thing on the face of the earth . . .

. . . groping for new and better ways of survival . . .

. . . survival largely by instinct . . .

. . . and, in one of nature's most amazing creations, survival by imagination, by thought, by the intelligence of the human brain that is able to read this right now!

it's the story of nature as only TIME LIFE BOOKS could tell it!


LIFE NATURE LIBRARY
THE SEA
Marine Arms and Armor

To tell nature's story, a story brimming with life of every description . . . to cover it with authority and excitement . . . TIME-LIFE Books pooled the talents and knowledge of hundreds of eminent naturalists, writers, photographers and artists. Once you examine *THE SEA*, we're sure you'll want to keep it . . . and keep on receiving more volumes (at approximately two-month intervals, each with the same 10-day free examination). Over 2,500,000 homes now have LIFE Nature Library books — to keep alive the wonder, mystery and beauty of the natural world.

For full details see the attached postpaid order card. If card is missing, write to: TIME-LIFE BOOKS Dept. 1001, TIME & LIFE BUILDING., CHICAGO, ILLINOIS 60611.

- Each volume is 8½" x 11"
- Permanent hard covers; printed in full color
- Approximately 190 pages, with illustrations on almost every page

I'll drink to that.

KAHLÚA® Splash. What a fresh idea.

The cocktail's been given a new twist. With an ounce of Kahlúa, a splash of soda, and a squeeze of lime. On the rocks. A drink to have any time good taste is in order.

It's so easy to get fresh with Kahlúa. We tell all in our recipe book. Yours for the sending. Because you deserve something nice.

Kahlúa. Coffee Liqueur from Sunny Mexico. 53 Proof.
Jules Berman & Assoc., 116 No. Robertson Blvd., Los Angeles, Calif. 90048

the feeder tried valiantly to defend it against four others that discovered it later.

Then I set up two feeders, and defense, although attempted with vigor, became impossible. Syrup consumption was enormous and we had a month of engaging activity around the cabin. But the following summer, when a feeder was reactivated, no birds came.

Had we diverted them the first year from their normal sources to an abnormal source with neither minerals nor vitamins, thus decimating the lot? Had we encouraged the production of more young, which were unable to survive on local sources until we got there in late summer? Or was this merely a normal fluctuation in the population?

What is the effect of encouraging these lovely birds to alter their feeding habits to sources that provide nothing but calories?

NAT G. HASELTINE
San Rafael, California

Scientists and the Bomb. III

I was greatly saddened that you published Allen Duffis's letter, "Scientists and the Bomb" [December, 1973].

Whatever the minor points surrounding Japan's surrender in 1945, there can be little doubt that the scientists, and especially the leading politicians, directly involved in dropping the atomic bombs on Hiroshima and Nagasaki and in carrying out the unrestricted air raids on Germany and the European mainland were, indeed, "barbarians"—an expletive far too mild in view of their conduct. What is even more disturbing, however, is Arthur Galston's original article. He indulges in overblown nationalist rhetoric in praise of the unchallenged superiority of American science, education, and agriculture. Nothing could be more distorted. To cite just one lesser example: numerous regions throughout Europe, Southeast Asia, China, and Japan show far greater average annual crop yields than does American agriculture, their main stumbling blocks being relative lack of land and high population densities. Many of them have been carrying on intensive cultivation for centuries, and with little fanfare.

DR. ANDREAS R. WESSERLE
Milwaukee, Wisconsin

BRIAN BRAKE, MAGNUM

You won't be stunned by New Zealand's fiords.
Not after you've seen
New Zealand's alps, glaciers, geysers,
volcanoes, fern forests and
beautiful beaches.

Alps covering an area larger than all Switzerland; geysers hurling steamy plumes high into the air; smoking volcanoes; the largest glacier anywhere in the world outside the Pole. For sheer scenic splendor, New Zealand is unmatched by any country on earth. For warm hospitality, you can't meet the match of the friendly New Zealanders. For more information about New Zealand, see your travel agent or send the coupon to us, and we'll send you our new free Kiwi Travel Pack, containing colorful brochures which will tell you everything you will want to know about New Zealand . . . the Land of the Long White Cloud.

NEW ZEALAND GOVERNMENT TOURIST OFFICE,
Department NH-24
153 Kearny Street, San Francisco 94108; 630 Fifth Avenue, New York City 10020; or 510 W. Sixth Street, Los Angeles 90014.

Please send me your new Kiwi Travel Pack.

☐ I am interested in information on nearby Australia, too.

Name______________________________

Address____________________________

City_______________State________Zip______

Sizing Up Human Intelligence

We do not have the largest brain in the animal kingdom, so what makes us think we're so smart?

"Size," Julian Huxley once remarked, "has a fascination of its own." We stock our zoos with elephants, hippopotamuses, giraffes, and gorillas. Jumbo was one of P.T. Barnum's greatest attractions until the beast's fatal collision with a train engine. This focus on the few creatures larger than ourselves has distorted our conception of our own size.

Most people think that *Homo sapiens* is a creature of only modest dimensions. In fact, humans are among the largest animals on earth; more than 99 percent of animal species are smaller than we are. Within our own order of approximately 190 species, only the gorilla regularly exceeds us in size.

In our self-appointed role as "lord of all," we have taken great interest in cataloging the features that permitted us to attain this lofty estate. The brain, upright posture, development of speech, and group hunting (to name just a few) are often cited, but I have been struck by how rarely our large absolute size has been recognized as a controlling factor of our evolutionary progress.

Despite its low reputation in certain circles, self-conscious intelligence is surely the *sine qua non* of our current status. Could we have evolved it at much smaller body sizes? One day, at the New York World's Fair in 1964, I entered the Hall of Free Enterprise to escape the rain. Inside, prominently displayed, was an ant colony bearing the sign: "Twenty million years of evolutionary stagnation. Why? Because the ant colony is a socialist, totalitarian system." The statement scarcely requires serious attention; nonetheless, I should point out that, first, ants are doing very well for themselves, and secondly, it is their size rather than their social structure that prevents the attainment of high mental capacity.

In this age of the transistor, we can put radios in watchcases and bug telephones with minute electronic packages. Such miniaturization could lead us to the false belief that absolute size is irrelevant to the operation of complex machinery. But nature does not miniaturize neurons (or other cells for that matter).

The range of cell size among organisms is incomparably less than the range in body size. Small animals simply have far fewer cells than large animals. The human brain contains several billion neurons; an ant is constrained by its small size to have many hundreds of times fewer neurons.

There is, to be sure, no established relationship between brain size and intelligence among human beings (the tale of Anatole France with a brain of about 1,000 cubic centimeters vs. Oliver Cromwell with well above 2,000 cubic centimeters is often cited). But this observation cannot be extended to differences between species and certainly not to ranges of sizes separating ants and humans. An efficient computer needs billions of circuits and an ant simply cannot supply them because the relative constancy of cell size requires that small brains contain few neurons. Thus, our large body size served as a prerequisite for our attainment of self-conscious intelligence.

We can make a stronger argument and claim that humans have to be just about the size they are in order to function as they do. In an amusing and provocative article (*American Scientist*, 1968), F.W. Went explored the impossibility of human life, as we know it, at ant dimensions (assuming for the moment that we could circumvent—which we cannot—the problem of intelligence and small brain size). Since weight increases so much faster than surface area as an animal gets larger, small animals have very high ratios of surface to volume: they live in a world dominated by surface forces that affect us scarcely at all (see my column in last month's *Natural History*).

An ant-sized man might don some clothing, but forces of surface adhesion would preclude its removal. The lower limit of drop size would make showering impossible; each drop would hit with the force of a large boulder. If our homunculus managed to get wet and tried to dry off with a towel, he would be stuck to it for life. He could pour no liquid, light no fire (since a stable flame must be several millimeters in length). He might pound gold leaf thin enough to construct a book for his size, but surface adhe-

McGraw-Hill
Color Slide Program
of the Great Masters
invites you to enjoy this entirely new

Color Slide
Art Lecture

in your own home for $1

with trial
subscription

LEONARDO DA VINCI

View 20 masterpieces by Leonardo da Vinci. Read fascinating commentary about the artist and each painting.

MAIL THIS POSTPAID CARD TODAY

First Class
Permit No. 26
New York, N. Y.

BUSINESS REPLY MAIL
No Postage Stamp Required if Mailed in the U.S.

Postage will be paid by

McGraw-Hill
Color Slide Program
of the Great Masters

McGraw-Hill Color Slide Program of the Great Masters, Dept. AY-128
1221 Ave. of the Americas, New York, N.Y. 10020

PLEASE enter my trial subscription to this completely new Color Slide Program and send me the *Leonardo da Vinci* Album (including 20 color slides and 40-page illustrated lecture). Bill me only $1, plus a few cents shipping. If I am not delighted with this introductory package, I may return everything within 10 days, cancel my subscription, and owe nothing.

If I do continue, you will send me a new Color Slide Album approximately every six weeks (for 10 days trial examination) and bill me at the subscribers' low price of $6.95, plus shipping. I may take as few or as many Albums as I like, and may stop whenever I wish. After my fourth shipment I will be given a choice of receiving all remaining albums in one convenient shipment, or continuing with single-album shipments.

Name. . . . .

Address. . . . .

City. . . . .

State. Zip No. . . . .

☐ Check here if you wish the Kodak Carousel 600 Projector included and remit $48.95, plus tax, with this card in envelope addressed to McGraw-Hill Color Slide Program of the Great Masters. If not delighted, return projector within 10 days for full refund.

This offer applies to U.S. and Canada only. AY-128

Imagine the thrill of viewing the famous "Mona Lisa" in the true colors of the artist's palette and the same size as the original in the Louvre! This work is just one of the priceless paintings by Leonardo da Vinci you and your family will enjoy when you receive your introductory Color Slide Album.

MAIL ATTACHED CARD TODAY

SEND NO MONEY—NO POSTAGE REQUIRED

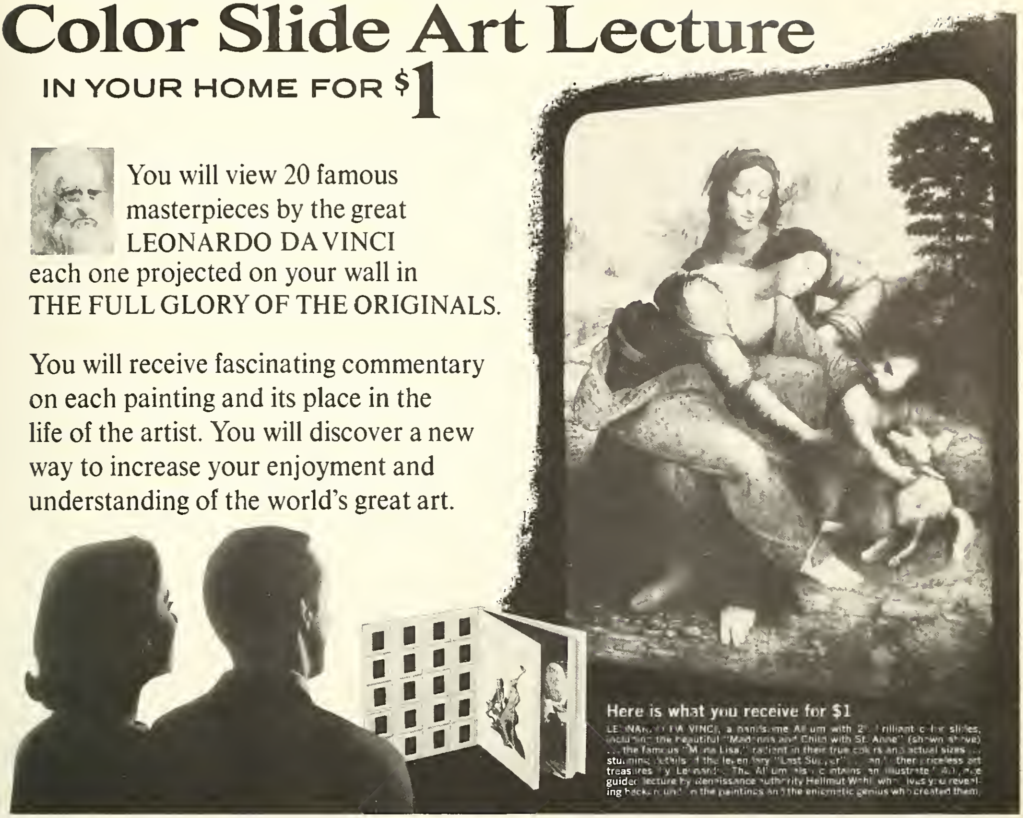
ENJOY THIS SPECTACULAR NEW

Color Slide Art Lecture

IN YOUR HOME FOR $1

You will view 20 famous masterpieces by the great LEONARDO DA VINCI each one projected on your wall in THE FULL GLORY OF THE ORIGINALS.

You will receive fascinating commentary on each painting and its place in the life of the artist. You will discover a new way to increase your enjoyment and understanding of the world's great art.



Here is what you receive for $1

LEONARDO DA VINCI, a handsome Album with 20 brilliant color slides, including the beautiful "Madonna and Child with St. Anne" (shown above) ... the famous "Mona Lisa," radiant in their true colors and actual sizes ... stunning details of the legendary "Last Supper" ... and other priceless art treasures by Leonardo. The Album also contains an illustrated 40-page guided lecture by Renaissance authority Hellmut Wohl, who gives you revealing background on the paintings and the enigmatic genius who created them.

A special demonstration offer from the new Color Slide Program of the Great Masters

THERE IS NO EXPERIENCE in the world of art more thrilling than to stand before a magnificent painting—and to learn about it from someone who knows the work well. Suddenly everything you see takes on new meaning, as you begin to understand fully what the artist is communicating through his particular choice of color, form, brush stroke, and theme.

Now, your family can share this exciting experience—and important cultural advantage—at home, through the entirely new *Color Slide Program of the Great Masters.* You view world-famous works of art projected on your own wall *in the full glory of the original canvases*—while a noted authority points out the significant aspects of each painting, and gives you fascinating background on the man behind the masterpiece.

This method of art education—the color slide art lecture—is widely used by leading museums and universities. It has never before been made available to families at home.

A new way to deepen your appreciation of art and artists

As a subscriber, you are offered a series of unusual albums, each containing 20 color slides of priceless paintings by a celebrated master. These superb 35mm slides were created by specialists in art photography working in leading museums and collections throughout Europe and America. The authentic colors of the original paintings, every subtle line and detail, are brilliantly revealed on these slides. They can be shown on *any standard home slide projector.* (If you do not own a projector, you may obtain one at low cost with your trial Album. See the special offer at the right.)

The color slides, however, are only one part of the Album. Bound into the center of each Album is an illustrated 40-page guided lecture which discusses the artist's life as well as each of the 20 paintings presented; its place in the development of the artist, its importance in the history of art, its reflection of the tastes and attitudes of the period.

As you view the paintings projected on your wall and read the absorbing commentary, you and your family will discover *a whole new dimension in the enjoyment of art.* If you have been disappointed by the inadequacies of small prints and art reproductions, you will be delighted with the thrilling visual experience offered by the *Color Slide Program of the Great Masters.* It is very much like taking your own "private tour" with an art expert guiding you through the world's finest collections.

The Program is flexible—the cost is low

Approximately every six weeks, you are offered a complete new Color Slide Album of 20 distinctive slides and an illustrated lecture. Forthcoming Albums will be devoted to the lives and works of such great masters as *Michelangelo, Rembrandt, Goya, Gauguin,* and *Picasso,* as well as *Rubens, Van Gogh, Lautrec, Chagall,* and other outstanding artists from every major period.

If the slides were available from museums, you would expect to pay as much as $15 a set. Yet, as a member of this new Program, you pay only $6.95 for each complete Album—including 20 color slides and 40-page illustrated lecture. You may take as few or as many as you like, and may stop whenever you wish.

Accept this $1 demonstration offer

To introduce you to the *Color Slide Program of the Great Masters,* we will send you the Color Slide Album, *Leonardo da Vinci* (described above), for 10 days trial. If you are delighted with the demonstration, send only $1, plus a few cents for shipping. Thereafter, you will be offered a new Album approximately every six weeks at the low price of only $6.95. You will also be given the opportunity to elect to receive remaining volumes. If not thrilled, however, simply return everything within 10 days, and you will be under no further obligation. Mail the attached card today.

IF YOU DO NOT HAVE A PROJECTOR, here's an unusual opportunity. We can offer you the sensational Kodak Carousel 600 Projector supplied with a 500-watt lamp, and 3-inch *f*/3.5 Ektanar lens. This top-rated projector shows all regular 2"x2" 35mm slides. It has dependable gravity feed and you have instant access to any slide at any time. List price $64.95—subscribers' price only $48.95, plus tax. Remittance must accompany trial subscription form. If you are not completely delighted with the projector, you may return in 10 days for a full refund.

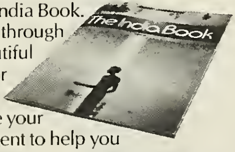
If Reply Card has been removed, write Color Slide Program of the Great Masters, Dept. AY-128
1221 Ave. of the Americas, New York, N.Y. 10020.

Our free book of tours to India will free you from another ordinary trip to another ordinary place.

The India Book is a gift to you from Air-India. It's filled with extraordinary tours of an extraordinary land.

The tours in The India Book are as different as India is. Whatever the duration of your stay, price range or special interest, there's a special tour for you in The India Book.

You can be there this year. Send for The India Book. Wander through the beautiful full-color photos. Then see your travel agent to help you with your arrangements.



AIR-INDIA
666 Fifth Ave., N.Y., N.Y. 10019
Yes! I'd love a
free copy of The India Book.

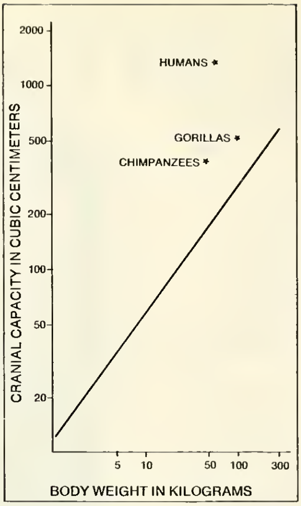
Name

Address

City

State, Zip NH-2

We work all day to make your night with us a dream.



Body weight and brain weight tend to vary systematically in mammals. The line plotted on this logarithmic graph indicates the average relationship between brain size and body weight. While chimpanzees and gorillas are somewhat above average, humans have much larger brains for their size.

sion would prevent the turning of pages.

Our skills and behavior are finely attuned to our size. We could not be twice as tall as we are for the kinetic energy of a fall would then be 32 times as great, and our sheer weight (increased eightfold) would be more than our legs could support. Human giants of eight to nine feet have either died young or been crippled early by failure of joints and bones.

At half our size, we could not wield a club with sufficient force to hunt large animals (for kinetic energy would decrease 32-fold); we could not impart sufficient momentum to spears and arrows; we could not cut or split wood with primitive tools or mine minerals with picks and chisels.

Since these all were essential activities in our historical development, we must conclude that the path of our evolution could only have been followed by a creature very close to our size. I do not argue that we inhabit the best of all possible worlds, only that our size has limited our activities and, to a great extent, shaped our evolution.

A human brain weighs about 1,300 grams (45.5 ounces) on the average; to accommodate such a large brain, we have bulbous, balloon-shaped heads unlike those of any other large mammal. Can we measure superiority by the size of our brains?

In absolute brain size, humans are surpassed by whales and elephants. But this fact does not confer superior mental ability upon the largest mammals. Larger bodies need larger brains to coordinate their actions.

We must find a way to remove the confusing influence of body size from our calculation. The computing of a simple ratio between brain weight and body weight does not work. A large number of very small mammals have higher ratios than humans; that is they have more brain per unit of body weight. This results from the correlation between brain size and body size. Brain size does increase with body size, but it increases at a much slower rate than body size.

If we plot brain weight against body weight for all species of adult mammals, we note that the brain increases at about two-thirds the rate of the body. Since the surface area of animals also increases about two-thirds as fast as weight, we conjecture that brain weight is not regulated by body weight, but primarily by the body surfaces that serve as end points for so many innervations. This means that because their bodies are bigger, large animals have absolutely larger brains than humans and that small animals have relatively larger brains than humans because body size decreases more slowly than brain size.

For mammals, if we plot brain size vs. body weight on a graph, we solve our paradox. The criterion that shows our superiority is neither absolute nor relative brain size—it is the difference between actual brain size and expected brain size at that body weight. To judge the size

If you've been saving up for a great receiver you just got a break.

The Pioneer SX-828 and SX-727 AM-FM stereo receivers have been acclaimed as the greatest values at $499.95 and $399.95 respectively. And so they are. But Pioneer, as the leader in high fidelity components, is totally committed to expanding the frontiers of high fidelity to achieve perfection in sound reproduction. And we are continuing to do so.

Shortly we will introduce three new stereo receivers — SX-1010, SX-939 and SX-838. They will continue the Pioneer tradition of unrivalled excellence through innovation in state-of-the-art technology in design and performance.

But until these new models are available, Pioneer dealers will be able to offer unusual savings on the SX-828 and the SX-727. Currently they're the best values in the world of high fidelity. With only a limited supply at Pioneer dealers, they won't last long.

The choice is yours. You can wait for Pioneer's new breakthrough models. If so, we admire your foresight. If you decide to take the substantial savings on the SX-828 or SX-727, we applaud your business acumen.

U.S. Pioneer Electronics Corp.,
75 Oxford Drive, Moonachie,
New Jersey 07074
West: 13300 S. Estrella, Los Angeles
90248/ Midwest: 1500 Greenleaf,
Elk Grove Village, Ill. 60007
Canada: S.H. Parker Co.

SPECS	SX-828	SX-727
IHF Music Power 4 ohms	270 watts	195 watts
RMS @ 8 ohms, Both channels driven @ 1KHz	60+60 watts	40+40 watts
FM Sensitivity (IHF)	1.7uV	1.8uV
Selectivity	+75dB	+70dB
Capture Ratio	1.5dB	2.0dB

PIONEER®
when you want something better

SELECTOR
AUTO
PHONO 1
PHONO 2
VOLUME
TAPE MONITOR
MONO
BALANCE
TREBLE
MHz
MODE
STEREO
SELECTOR
FM-AUTO
PHONO
MIC
AUX
BALANCE
VOLUME
LOUDNESS
TAPE MONITOR
TREBLE
FM MUTING

Why it pays to invest in the thin one.

Leitz Trinovid® binoculars are about half as bulky as conventional glasses of comparable power.

And they are also about twice as expensive.

The thin shape alone may justify the cost, but there are two other reasons: your left eye; your right eye.

When you use binoculars, they become an extension of your own optical system. And if they are not properly aligned they will subtly, but surely, tire and strain your eyes.

This is why it is important in binoculars that all components be of high quality, painstakingly crafted.

Leitz Trinovid binoculars meet these requirements and more. They are hand assembled. Their superb optics are color-corrected and anti-reflection coated. Each unit is perfectly aligned. The "roof prism" design that makes Trinovid thin and a unique internal focusing system make it possible to seal all the elements. So Trinovid is dustproof, highly water-resistant, and sturdy.

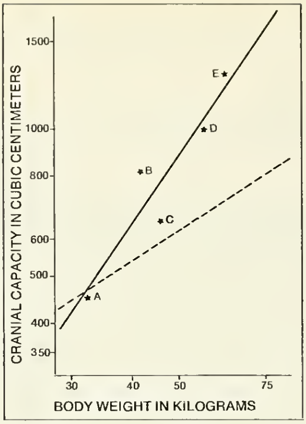
Trinovids are the only binoculars that offer the original owner a lifetime guarantee. (In case of a defect, return the unit postpaid and Leitz will either repair or replace it at our option.)

Discover why it pays to invest in the thin one. Try out Trinovids at your authorized Leitz dealer.

Write for a brochure and dealer list to E. Leitz, Inc., Rockleigh, N.J. 07647. Dept. H.

Leitz

The only binoculars with a lifetime guarantee.



Some of our early ancestors, who were smaller than humans today, had brains closer to the average, for their size, of all mammals, indicated by the dotted line. This is shown by A, Australopithecus africanus, *and* C, *the later African* Homo habilis. B *is Richard Leakey's find with a cranial capacity of 800 cubic centimeters. The more recent* D, Homo erectus *(Peking Man) and* E, *modern* Homo sapiens *have much larger brains than predicted by body weight alone. This logarithmic graph indicates that we have evolved larger brains at an exceptional rate (upper line) and apparently have reached new levels of intelligence.*

of our brain, we must compare it with the expected brain size for an average mammal of our body weight. On this criterion we are, as we expected, the brainiest mammal by far. No other species lies as far above the expected brain size for average mammals as does *Homo sapiens.*

This relation between weight and brain size gives us important insights into the evolution of the human brain. Our African ancestor, *Australopithecus africanus,* had an average adult cranial capacity of only 450 cubic centimeters. Gorillas often have larger brains, and many authorities have used this fact to infer a distinctly prehuman mentality for *Australopithecus.* A recent textbook states: "The original bipedal ape-man of South Africa had a brain scarcely larger than that of other apes and presumably possessed behavioral capacities to match." But *A. africanus* weighed only 50 to 90 pounds (female and male respectively—as estimated by Yale anthropologist David Pilbeam), while large male gorillas may weigh more than 600 pounds. We may safely state that *Australopithecus* had a much larger brain than other primates on the correct criterion of comparison with expected values for actual body weights.

The human brain is now about three times larger than that of our australopithecine ancestor. This increase has often been called the most rapid and most important event in the history of evolution. But our bodies have also increased greatly in size. Is this increase in brain size a simple consequence of bigger bodies or does it mark new levels of intelligence?

To answer this question, I have plotted cranial capacity against inferred body weight for fossil men who may represent our lineage: *Australopithecus africanus;* Richard Leakey's remarkable new find with a cranial capacity of 800 cubic centimeters and an antiquity of more than two million years (weight estimated by David Pilbeam from dimensions of the femur); the later African *Homo habilis; Homo erectus* from Choukoutien (Peking Man); and modern *Homo sapiens.* The results show that our brain has increased much more rapidly than the prediction based on compensations for body size alone.

My conclusion is not unconventional, and it does reinforce an ego that we would do well to deflate for the sake of other living creatures, and ourselves. Nonetheless, our brain has undergone a true increase in size not related to the demands of our larger body. We are, indeed, smarter than we were. Despite this, we are not as smart as some people like to think we are. ☐

You can help save Aurora Cortez for $15 a month. Or you can turn the page.

Here are some facts about Aurora Cortez, her family, and her town—Plato, Magdalena, on the coast of Colombia. No editorializing. No embellishment. Just facts.

Aurora is five years old. She lives with her parents and three brothers and sisters in a house made of mud and bamboo.

No electricity. No running water. No sanitary facilities. Aurora's father earns $1.00 a day herding cattle. And there is about a 50% chance that Aurora will grow up illiterate. Because it costs money to go to school in Colombia. Money her father doesn't have.

But for $15 a month through Save the Children Federation you can sponsor a Colombian child like Aurora. Send her to school. Improve her living conditions. Help her neighbors rebuild the bridge that connects Plato to the town's only hospital.

Help people—indeed, help an entire community—to help itself.

For you there are many rewards. The chance to correspond with a child. To receive a photograph. And progress reports. And above all, to know you are reaching out to another human being. That's how Save the Children works. But without you it can't work. So please: clip this coupon and mail it today. Now you can turn the page.

Save the Children Federation, founded in 1932, is registered with the U.S. State Department Advisory Committee on Voluntary Foreign Aid. Contributions are income tax deductible.

I wish to contribute $15 a month to sponsor a ☐ boy ☐ girl:

☐ **Where the need is most urgent**

☐ Africa
☐ Appalachia (U.S.)
☐ Bangladesh
☐ Chicano (U.S.)
☐ Europe
☐ Indian (U.S.)
☐ Inner Cities (U.S.)
☐ Israel
☐ Korea
☐ Latin America
☐ Middle East
☐ Southern Black (U.S.)
☐ Vietnam

Enclosed is my first payment:

☐ $180 annually
☐ $90 semi-annually
☐ $45 quarterly
☐ $15 monthly

☐ Instead, enclosed is my contribution of $____________

☐ Please send me more information.

NAME________________________ TEL. NO.____________

ADDRESS____________________________________

CITY_______________ STATE____________ ZIP________

David L. Guyer, Executive Director

SAVE THE CHILDREN FEDERATION

345 East 46th Street, New York, N.Y. 10017

NH 2/4

The End of an Energy Orgy

Americans have gobbled up sources of energy for centuries. Now we must learn to diet

By next month, the United States, particularly the northeast, may be in danger of economic strangulation because of the fuel shortage. How could we be so ill-prepared? The answer is that we are the victims of a defective pattern of thinking that originated in a series of historical accidents in the nineteenth century. The ultimate consequence of this erroneous thinking was inevitable; the Arab export embargo merely hastened the arrival of a crisis that would have arrived by 1979 at the latest.

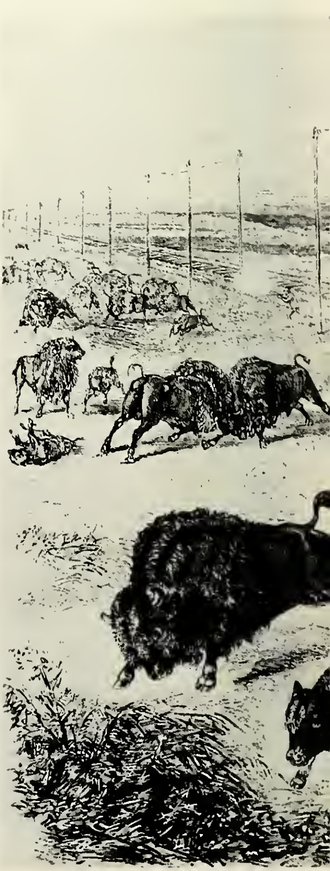
In the nineteenth century we consumed wood, whale oil, and buffalo at astonishingly high rates. This pattern of resource use had profound implications on our later development. By 1850, 91 percent of our energy came from wood, and Americans were consuming fuel wood at an annual rate equivalent to the burning of 7,091 pounds of coal per person. To put this into perspective, in 1969 the total consumption of energy in all forms, in pounds of coal equivalents, was only 6,993 pounds per capita in Switzerland, and 6,235 in Japan. Thus, by the mid-nineteenth century, and perhaps even earlier, the United States—by cutting down the trees that surrounded its population—had attained a level of energy consumption that two of the most technologically sophisticated nations on earth would not reach until about 120 years later.

Wood did not decline significantly as an important source of fuel until 1880. It was replaced by coal and some oil, which had been used for over two decades. Long before wood ran out, other sources of energy became available. This pattern was repeated three times: coal became important before wood ran out; oil became important before coal ran out; and gas became important before oil ran out.

Two other resources, now almost forgotten, led the United States early in its development to a very high level of resource exploitation. By 1847, we were using 313,000 barrels of whale oil per year, or about 0.014 barrels per person per year. This got the United States into early and heavy use of oil for lubrication and illumination and set the stage for heavy use of crude petroleum shortly thereafter. To indicate the magnitude of forward momentum in oil use, by 1928 the United States consumed 7.62 barrels of crude oil per person, while in the rest of the world, average per capita use in the same year was only 0.19 barrels.

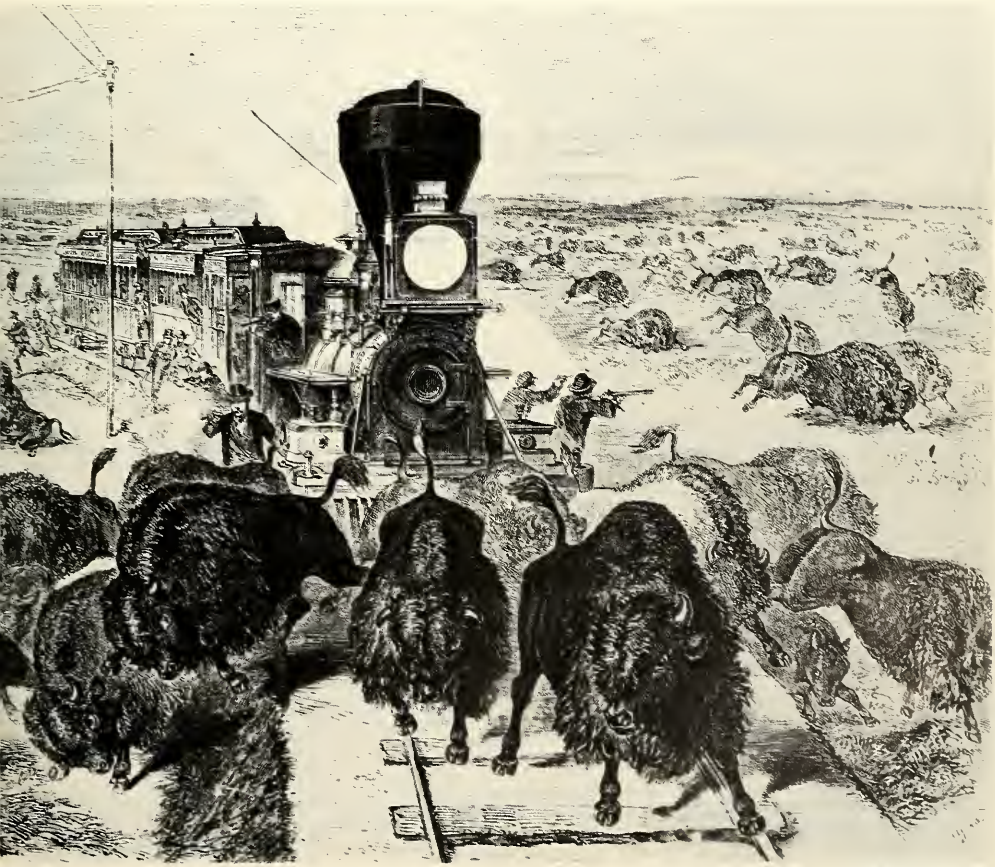
The sperm whaling industry collapsed from overexploitation in 1881, but by then crude oil in quantity was available to replace whale oil. As in the case of the shift from fuel wood to coal, the United States never got the chance to learn an important lesson: that the conversion from one energy economy to another takes a long time. Historically this country has taken from forty to sixty years to get a new source of energy to the point where it could supply 10 percent of the national energy needs.

We acquired a taste for meat early. By 1872 we were killing seven million buffalo a year. A meat-eating society requires more land per capita to produce food than a largely plant-eating society. This is because of the lower efficiency in solar energy use, which must pass through one extra trophic level in the food pyramid, from plants to herbivores, before it reaches man. A superabundance of buffalo, combined with a greater availability of space per capita relative to other countries, taught us to ignore land or food as critical limiting resources. The ultimate result has been that farmland has been cheap compared to the same land converted to urban purposes. Even in the last few decades the value of land used for farming has declined relative to the value of that same

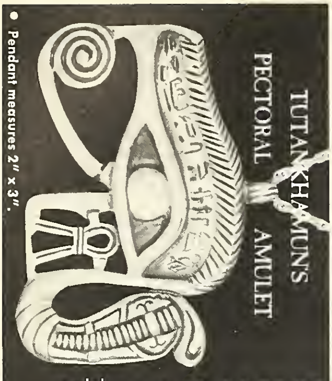


land used for urban purposes. The consequence has been a trend toward incredibly sprawling cities with no real urban center. Only in Canada and Australia have similar cities developed, and in those countries, too, the temporary superabundance of farmland has deceived the population into thinking it did not matter if cities grew by spreading out, rather than up. In countries where farmland is at a premium, the typical city building is seven or more stories. Indeed, in many old European cities, it is difficult to find a building less than seven stories high, and new buildings on the outskirts of cities are

Train passengers slaughter buffalo during an excursion on the Kansas-Pacific line.



THE BETTMANN ARCHIVE, INC.



TUTANKHAMUN'S PECTORAL AMULET

• Pendant measures 2" x 3".

Original found in Tutankhamun's tomb, 18th Dynasty Egypt. This replica depicts rearing uraeus guarding the sacred eye, with the sa (protection) hieroglyph beneath it on the inner side. Suspended from 24" rope chain—it makes both a beautiful and historic gift!

- Sterling Silver Pendant .... $ 65.
- 14 Karat Gold Pendant .... $450.
- 18 Karat Gold Pendant .... $650.

• Regular insured postage $1.50—Airmail $1. additional.
• BankAmericard & M.C. accepted. • Money back guarantee.

FREE COLLECTOR'S CATALOG — 24 pages picturing over 75 ancient world relics from BC to AD. Plus, catalog featuring over 50 ancient jewelry replicas in precious metals.

aladdin house, ltd.
Dept. N-274 • 648 Ninth Ave. • N.Y. 10036

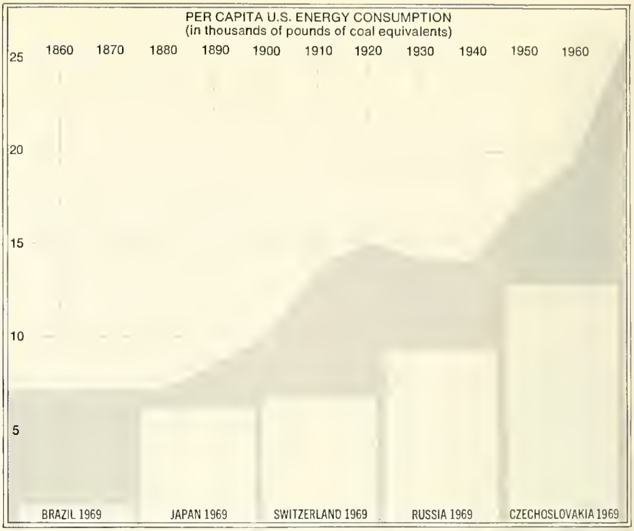
Cloud-Soft Travelers

Down Sox For Men and Women

Tuck these Sox into a travel bag, wear them to bed, enjoy them as slippers or as inner sox for your insulated pacs or waders. Bauer Goose Down is quilted in soft, tough Nylon taffeta. **Colors:** Red, Winter Blue, Taupe, Powder Blue. **Sizes:** Specify men's or women's shoe size and we will supply proper fit. **0123** Sox, pair $7.95 postpaid.

Order Today! Money Back Guarantee!
Enclosed is my check or money order for
$_______. (Add sales tax where applicable.)
Please RUSH my 0123 Goose Down Sox.
Men's Size________Color________
Women's Size________Color________
Name________
Address________
City________
State________Zip________
☐ Send me FREE your new color catalog of over 1000 exciting outdoor products.

Eddie Bauer®
Dept FNH 1737 Airport Way S Seattle, Wa 98124



often ten to thirteen stories high.

Unconsciously, we learned several lessons from our experiences with resources in the last century; unfortunately, they were incorrect, the result of temporary situations in which we managed to get by because of extraordinary luck. One conclusion we reached was that resources are limitless, so there is no need to conserve them. This produced an economy characterized by low unit costs for resources relative to the cost of labor. Since there is no historical precedent for high resource prices, politicians today hesitate to permit prices to increase sharply in the interests of conservation. We were also taught that it doesn't matter if anything runs out, because there is always a substitute. This is one basis for the widespread and unshakable belief that atomic energy will arrive in the nick of time. Also important, because there was always a substitute ready in time, we have come to ignore the great importance of time itself as a critical limiting resource. Thus, we are unaware of the enormous time required to get new technologies working.

Our experiences in the nineteenth century led us as a nation to acquire excessive faith in "Yankee ingenuity." Because of our superabundance of resources, our ingenuity never encountered an insoluble problem. Thus, we overemphasize what we can accomplish, and naïvely believe that nuclear energy, solar energy, wind, or gravitational fields will produce another miracle for us.

Each nation does what it can and what it must. Other countries have the same ingenuity as ours: the airplane, airship, automobile, and many other inventions were developed in several countries almost simultaneously. But lacking our resource base, other countries evolved in the direction of more efficient energy use. This meant trains and buses instead of cars; it also meant compact cities and different diets. Thus, while we instinctively used energy to solve all our problems, always deluding ourselves that high energy use means high technology, many other nations tended to equate high technology with great efficiency of resource use.

For a long time, advertising and our natural instincts to acquire goods have led us to use up much of our resources. Because we came to believe that our wants were insatiable, we never worried much about the possible consequences of market saturation. But wants can be satisfied, and the simultaneous total satisfaction of a wide variety of wants is having a profound effect on our economy. Even without the Arab oil embargo, we would have discovered that economic growth was slowing because we had a glut of cars, planes, luxury resort hotels, upper-class housing, and electronic goods.

Our most serious problem, however, is our selection of an erroneous set of national goals, which

Introductory offer

67¢

a week…
and you choose
your term!
(13 weeks minimum)

SUBSCRIBE NOW

The
Wall Street
Journal
A Dow Jones Publication

Yes! Start my subscription for ____ weeks at 67¢ a week (minimum 13 weeks). Bill me later.
☐ I prefer one year at $35

Name ______________________
Address ______________________
City ______________________
State ______________ Zip ________

GUARANTEE: You may cancel at any time and receive a refund for the undelivered portion of your subscription.

Price good only in the U.S. and Possessions and Canada.

2A430

For just 67¢ a week
acquaint yourself with the national business daily read by over 4 million people interested in the wide world of business news.

The
Wall Street
Journal

Detailed coverage
of anything, anywhere,
that can affect
you or your business

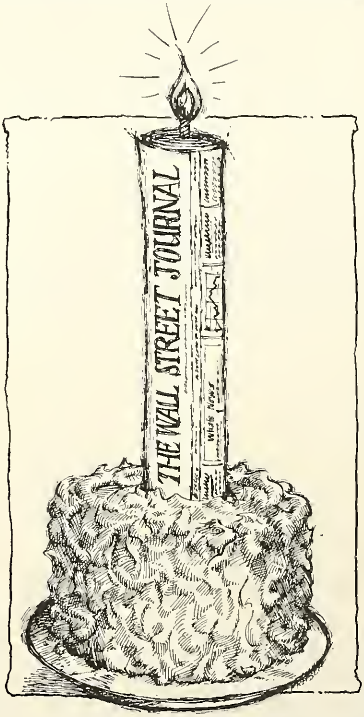
FIRST CLASS
Permit No. 22
Chicopee, Mass.

BUSINESS REPLY MAIL
No Postage Necessary if Mailed in the U.S.

Postage will be paid by:

THE WALL STREET JOURNAL
200 Burnett Road
Chicopee, Massachusetts 01021

In 30 days, you'll be a month older. Why not be a month smarter?



How much more are you going to know a month from now? How much new information will you have about business in general, or about *your* business? How much smarter will you be?

It would be nice—wouldn't it?—if the older you got, the smarter you got.

The Wall Street Journal may be able to help.

The Wall Street Journal is a national, daily business publication (the *only* national daily business publication) written and edited to help its readers to know more, to have more relevant information, to be smarter. Every business day, it reports news of just about anything happening anywhere in the world that can be of interest to anyone who works for a living. Not just stocks and finance, but all kinds of news, trends, developments that can affect business — *your* business. All kinds of information, every day, that can help you make the business decisions you have to make every day.

Why not try The Wall Street Journal? If you fill out and mail in the attached card, we'll send The Journal to your home or office for 67¢* a week for 13 weeks (or longer, if you want). If someone has beaten you to the card, just write to The Wall Street Journal, 200 Burnett Road, Chicopee, Mass. 01021. 30 days after you receive your first issue, you'll be a month smarter.

The Wall Street Journal

*Prices good in United States and possessions and Canada.

NO MATTER WHERE YOU LOOK
YOU SEE MORE
WITH A QUESTAR

With Questar Field Model's new Fast Focus the photographer gets those spur-of-the-moment shots—from the eye of a fly to the craters of the moon . . . *instantly!*

GROUND SQUIRREL PICTURES ARE FROM QUESTAR'S NEW BOOKLET CONTAINING 150 NEW PHOTOGRAPHS BY QUESTAR OWNERS: $1 TO COVER HANDLING-MAILING COSTS ON THIS CONTINENT. AIR TO S.A., $2.50; EUROPE AND N. AFRICA, $3; ELSEWHERE, $3.50.

QUESTAR

BOX Q60, NEW HOPE, PENNSYLVANIA 18938

THE BETTMANN ARCHIVE, INC.

were based on our luck in the nineteenth century and which we have advertised with great vigor internationally. Rather than being concerned with the quality of life, we are committed to maximizing gross national product by maximizing the flow of matter and energy through the economic system.

Our current national goals maximize resource depletion, increase pollution, reduce life expectancy, destroy our city centers, and give us a slow, inconvenient, unhealthy form of travel. Shifting our goals to maximizing the quality of life would lead to less resource depletion, less pollution, higher life expectancy, more pleasure (more culture, entertainment, and less haste), and a faster, more convenient, transportation system less detrimental to health.

What happens to us if we don't change? We are in real danger of simply running out of everything, while still expecting substitutes for soon-to-be depleted resources to show up, as they did many times before. The authors of *Limits to Growth* have alerted many people to a series of difficulties that can befall us. This book, however, was based on a highly aggregated model in which much detail was omitted by design (to expose the essential features of the big picture). But an interesting thing happens when we disaggregate to determine the impact of additional mechanisms on limits to growth. We discover that the timetable for troubles resulting from excessive growth is moved closer to the present.

A highly aggregated global

In a photo taken about a half-century ago, cars and trucks are shown waiting to enter New York's Holland Tunnel.

Barrels of sperm oil fill the whaling dock at New Bedford, Massachusetts, in the last century.

model tells us that given present trends, a particular resource will be gone in thirty years. A more detailed model that deals with the 175 nations on earth reveals additional difficulties because the nations placing the heaviest demands on the resource may not be those with the greatest supply. And a nation with a supply surplus may not allow all of that supply to go to another nation with excessive demand. The Arab oil embargo is the first major example of this phenomenon, but we will undoubtedly see many similar occurrences involving many critically important minerals.

Less highly aggregated models reveal additional sources of difficulty when we divide the population into age classes. Rapid growth leads to very large imbalances in the age structure of the population, which quickly become so severe that, in reaction, birthrates drop in developed countries. This is currently leading to a situation in which only 69 percent as many children will be born in the United States in 1975 as in 1960.

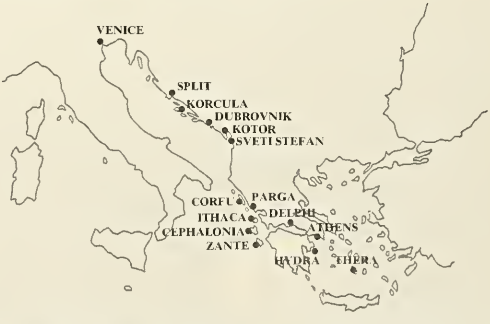
THE BETTMANN ARCHIVE, INC.

The American Museum of Natural History announces an "Adriatic Odyssey"

Sveti Stefan, Yugoslavia's finest resort, is connected to the mainland by a causeway of white sand.

Members of The American Museum are invited to join a special springtime study-cruise of the Adriatic Sea and the Greek Peloponnesus, May 16-27, 1974. You will be traveling with representatives of the Museum's scientific staff, who will enrich your twelve-day idyl with their wide and special knowledge in the fields of anthropology and archeology.

After embarking at Venice, our ports of call will include five stops along the Dalmatian and Macedonian coasts and nine sites of Greek antiquity. You will live aboard the elegant *m/v Neptune,* sailing each day to fascinating experiences.



Rates, which include airfare and a tax-deductible contribution to the Museum, start at $1185. For the comfort of our passengers, participation is limited to two-thirds of the capacity of the vessel. Write now for further details: Mrs. Marie Caufield, The American Museum of Natural History, Central Park West at 79th Street, New York, New York 10024.

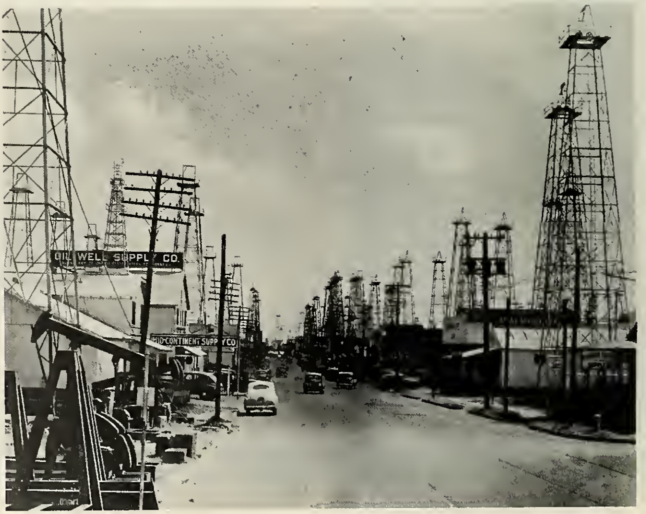
No comparable decline over a fifteen-year period has ever occurred in U.S. history, not even from 1920 to 1935. What will happen to U.S. economic growth by about the year 2030, when the fifty-five-year-old class of 1975 will be trying to support the seventy-year-old class of 1960? Imbalances in year-class strength alone can bring an end to excessive economic growth.

We have deluded ourselves because of a set of historical accidents that were never perceived as unusual. Now we must quickly unlearn some erroneous lessons so that a future sequence of incidents such as the one that led to the Arab oil embargo will not catch us by surprise.

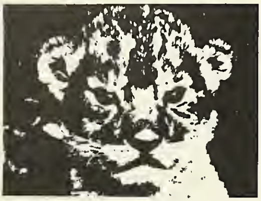
We should not perceive the energy crisis as a problem, but rather as a glorious opportunity, ripe for exploitation. Our history with wood, sperm whales, buffalo, coal, oil, and gas leaves little doubt about our ability to exploit glorious opportunities. We can do this in two ways: by converting to more efficient use of resources and by shifting a higher proportion of the labor force from manufacturing and transportation into service occupations. The improved efficiency would lead to more sophisticated, convenient technology for everything: transportation, communication, entertainment, and appliances. Shifting the labor force would bring better medical care and a cultural renaissance. Anyone for modern mass transit and community art centers? The more immediate problem is the transition period. The transition can be facilitated by community-organized car pools, dial-a-grocery delivery services, small companies marketing solar-powered home heating and cooling units, and aggressive organization of community theater, dance, music, and art groups. Also, now, when we are in danger of an explosion in unemployment, is the opportune time for massive political pressure to get cradle-to-grave, guaranteed comprehensive health care for everyone. This would certainly take up some of the slack in employment.

The time has come, in a sense, for America to grow up. For some two centuries we have lived luxuriously off the energy-rich land, like a spoiled child off wealthy parents. Now, crises are forcing us into a period of maturity, to an awareness of the consequences of high energy consumption. The development of this maturity could bring a style and richness of life that Americans have never known. But it will take all our Yankee ingenuity—and more—to reach such a golden age. ☐

Oil well rigs lined the main street of Kilgore, Texas, in the 1930s.



THE BETTMANN ARCHIVE, INC.



BOB CAMPBELL

We'll die ..!

Survival of the fittest and fleetest on E.Africa's plains is hard enough, without poachers, their snares and fires added to our battle. They, and those who sent them, are after our skins, hides, furs, claws, hooves, horns and teeth. But believe me, we need them more than they. However if we don't get help soon, we'll go the same way as the Dodo. To extinction.

You are our hope and our help, and the link between us is the EAST AFRICAN WILD LIFE SOCIETY, East Africa's own conservation group, and the first of its kind in the tri-nation area of Kenya, Uganda and Tanzania.

It is non-profit, non-governmental, a body that has funded a list of conservation projects since 1961, as long as your arm. Every cent of your membership (US $11.00) goes directly to game conservation projects; and not one cent to "overheads".

THE *WILDLIFE* GETS ALL THAT YOU GIVE

As a member of the Society you will also receive a year's subscription to AFRICANA the quarterly wildlife magazine. And for those who are interested in gifts of every description which have to do with the game of East Africa, a 32 page colour brochure is available for US$ 1.00. They are also on sale from our gift shop and gallery in the Nairobi Hilton Hotel.

And while you're reading this, remember, that the Society is working round the clock on our behalf, in the field of education, anti poaching, research and animal rescue.

USA Representative:
Miss Alice Smith Box 1325, Chicago Ill. 60690

EAST AFRICAN WILD LIFE SOCIETY
Box 20110 Nairobi Kenya.

Please enrol me as a member.
I enclose US.$11.00 for my year's membership.

Name ______________________

Address. ______________________

Rumor has it William the Conqueror stocked up in our supermarkets.

He knew a good thing. Silks and spices, gold, ivory, peacock feathers. And the beautiful bargains are still to be had. In places like this—the market in our walled city of Harrar. Arab traders first came here in the 7th century.

The Harrar market—and the market in Addis Ababa, largest of its kind anywhere—are still going strong. Same bargains, same friendly haggling. Same diversity of bargain hunters, coming on foot, camel, donkey, and by car. But that's Ethiopia, the Hidden Empire. Hidden from most of the world for centuries.

Discover Ethiopia. Before everyone else does. The bargains are waiting. And so is the welcome. Talk to your travel agent or fill in the coupon at the bottom of the page.

I'd like to be among the first to discover Ethiopia, the Hidden Empire, with Ethiopian Airlines (daily Boeing flights from Europe). Please send me brochures.
Ethiopian Airlines, 200 East 42nd Street, New York, N.Y. 10017, Tel. (212) 867-0095.
Dept. HN-11

Name ______________________________

Address ____________________________

City ____________ State ________ Zip ________

ETHIOPIAN
AIRLINES
The Key to the Hidden Empire

The Northernmost People

Greenland's Polar Eskimo have survived game shortages, diseased whalers, and the U.S. Air Force

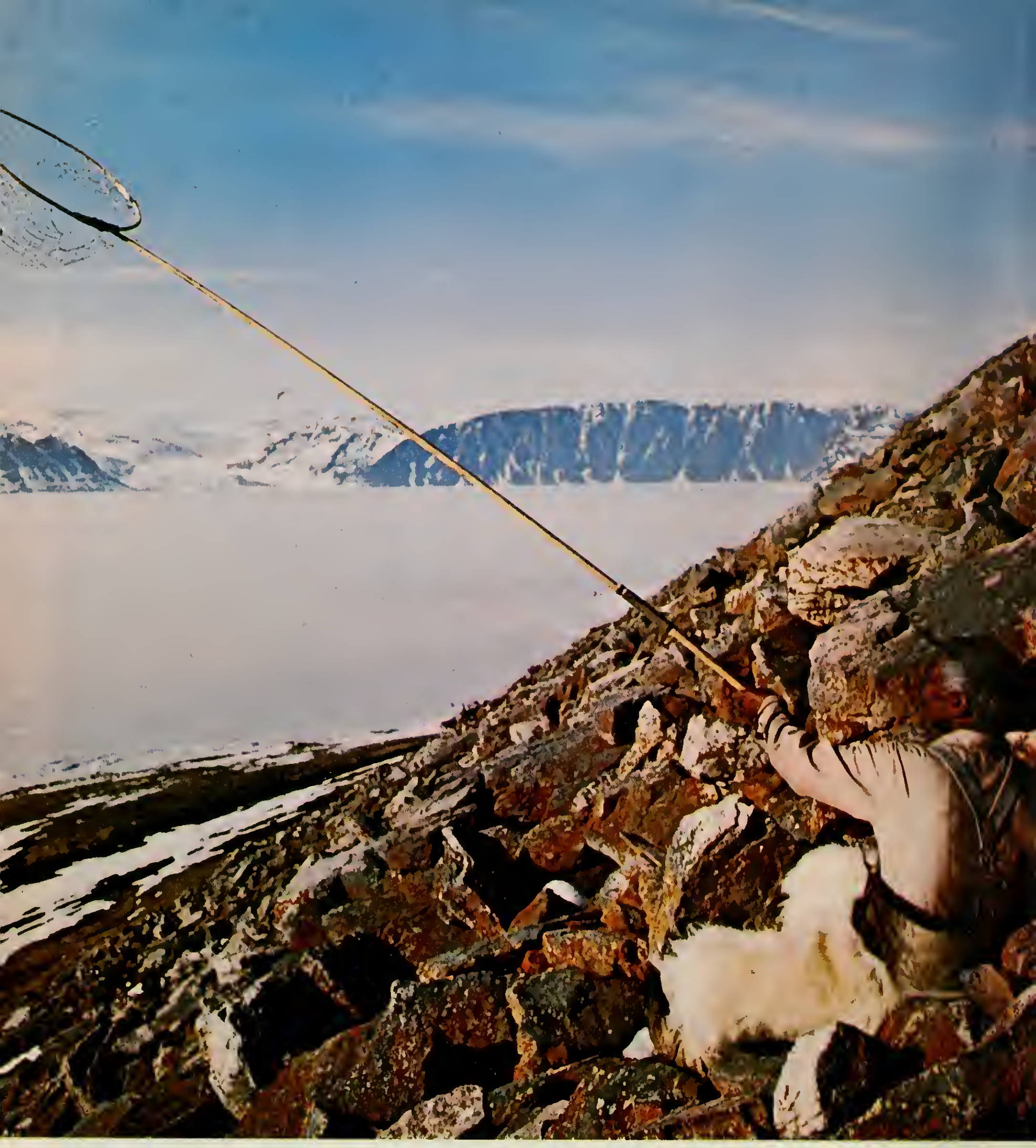
The old Eskimo who picks me up with his dog team near the Thule Air Force Base in northwest Greenland is very dark. He is Anaqaq Henson, the son of Matthew Henson, Admiral Peary's black servant. On a dresser in his self-built, spacious one-room house in the village of Moriussaq, Anaqaq has placed a picture of Matthew Henson holding the U.S. flag, flanked by four Eskimo. "My father at *Kalalerssuaq* [the big navel]," he says proudly. The Eskimo have a second, more ominous name for the North Pole: *Kingmersoriartorfigssuak*, "the place where one only eats dogs."

To reach Kanâk, main settlement of the Polar Eskimo, we travel north across an arm of Greenland's mighty ice cap. Most of the time we ride on the sled. Anaqaq is proud of his powerful, well-fed dogs. At 65 he is still one of the best hunters in the Thule district.

When the ascent is too steep, we run, Anaqaq skillfully guiding the heavy sled by its stanchions. He stops frequently. "One is tired," he says. In truth, he is not tired at all, but he knows I am and gives me a chance to rest without losing face. The Polar Eskimo, wrote explorer-writer Peter Freuchen forty years ago, "are the most tactful people in the world."

The north wind cuts into us as we cross the wide expanse of Inglefield Bay, but Anaqaq doesn't mind. His clothing makes him nearly impervious to cold. He wears a caribou parka, pants of polar bear fur, outer boots of ringed sealskin

Text and photographs by Fred Bruemmer



with soles of strong bearded seal leather, and inner boots of down-soft hare fur. A layer of dried grass between inner and outer boots provides additional insulation.

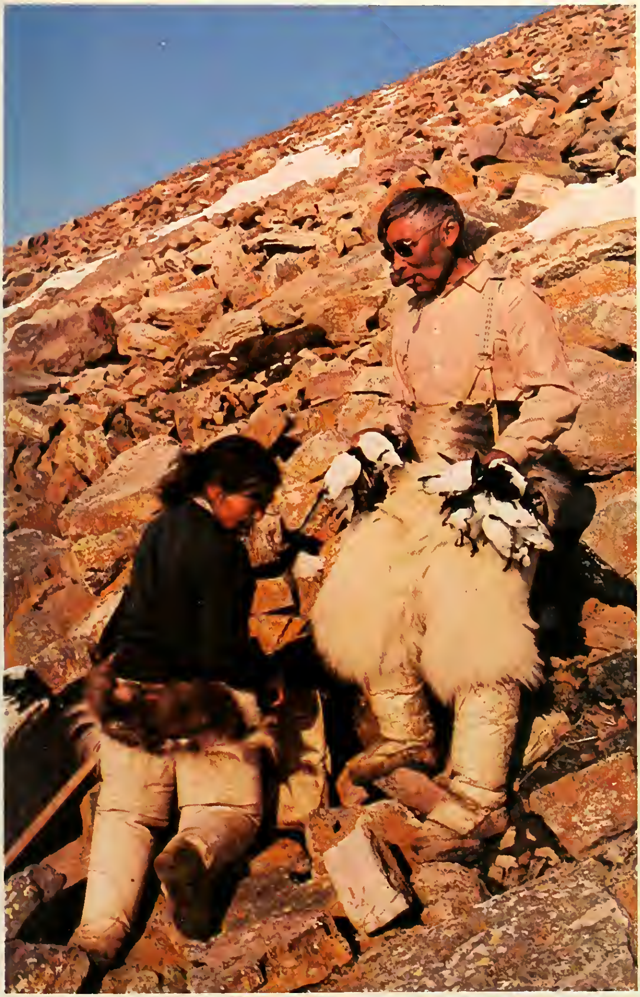
To get polar bears for pants, Eskimo men make hunting trips lasting from two to eight weeks. Hunting is a passion, and the pants are a symbol, albeit a warm, practical, and comfortable one, of prowess and prestige. You can easily spot the great hunters. Their wives' hip-high sealskin boots are trimmed with the silver-glistening mane fur of the bear, and even their small sons wear polar bear trousers. The Polar Eskimo kill, on the average, twenty-five bears a year. They could sell the skins for a fortune at the

Long-handled nets are used to snare low-flying dovekies. Kiviaq, *a favorite Eskimo food, is made from the carcasses of these seabirds, fermented for a year in blubber-lined sealskin bags.*

U.S. air base (reportedly, for $500 and up), yet no skins are offered for sale. All are used for clothing. Two men usually travel and hunt together, sharing the skin of a killed bear. A third man can claim a part simply by rushing up and touching the dead animal. It is in this way that some of the old men, and also young, inexperienced hunters, get the fur for their *nanut*, or polar bear trousers.

In Kanâk, I ask Anaqaq how much I owe him. "The office will make up your bill," he says. The local administrative office of the Greenland government sets the charter rates for dog teams because government employees, such as doctors and dentists, have to rely on this method of transportation to reach the isolated villages in the district. In this case, the office makes out the bill simply as a courtesy to Anaqaq.

At the office an efficient young lady tallies the charges up on an adding machine: so much per day per dog, so much for the sled, so much for crossing the ice cap, and gives me a neatly itemized bill for the $160 I owe Anaqaq for the four-day trip (including his return to Moriussaq). It is the only charter trip of my six-month stay with the Polar Eskimo. The rest of the time I am a paying guest with various families, trying to learn about their way of life.



Anaqaq will stay a few days in Kanâk and visit relatives and friends; then he plans to go to the floe edge, the limit of landfast ice, near Narssaq, a favorite camping area forty miles south of Kanâk, to hunt seal and narwhal.

Several hunters out of Kanâk have returned from Narssaq, their sleds loaded with meat. The hunting mood is contagious, and as Anaqaq wants to try his luck, he sends a telegram home saying he will be delayed. It is cheap—twenty øre (about three cents) per word. Because Eskimo words are often long, any with more than thirty letters count as two. Christian Lynge, the radio operator, says the longest word he knows of has 115 letters. Lynge is a *kalateg*, a "Greenlander," or part Eskimo and part Danish.

The Polar Eskimo are *Inuit*, "the people"—the Eskimo's traditional name for themselves—and occasionally, as if to emphasize their strange history and their status as the world's northernmost Eskimo group, they refer to themselves as *Inugssuit*, "the great people."

For at least 2,000 years the Thule district has been both bridge and oasis to successive Eskimo cultures. Spreading east from the region that today is the Canadian Arctic, the Eskimo crossed the narrow Smith Sound from Ellesmere Island. Some moved to south Greenland, others to northeast Greenland. Thule itself has probably been populated since the Eskimo first arrived in the area, because it was (and still is) immensely rich in game.

Into this northernmost portion of Baffin Bay flow the currents from three large bodies of water: Lancaster Sound, Jones Sound, and Smith Sound (all discovered and named by William Baffin in 1616 and then forgotten for two centuries). Their rushing, upwelling waters are not only extremely rich in nutrients and consequently in plankton, but they also keep the bay from freezing even in the coldest winter, forming the vast body of open water in the Arctic Ocean that nineteenth-century whalers called the North Water. Some of the world's largest seabird colonies are here, along with a magnificent wealth of marine mammals: whales, walrus, and seals—a sort of Eskimo Eden.

In the late sixteenth century the climate changed. The "little ice age" began; it became colder and the Eskimo left the far north or died out. All, that is, except the Polar Eskimo of the Thule region. They lost the art of kayak making, and after a while boats were only remembered as mythical craft. They abandoned the bow and arrow and forgot the existence of other people. They believed there was nothing but ice to the north and south, and that they, the 200-odd Polar Eskimo living along a narrow strip of land between the ice cap and the sea, were the only people on earth.

During fall, winter, and spring their food consisted mainly of sea mammals; in summer, probably entirely of birds.

With the end of the Napoleonic wars, the British Admiralty had ships and men available to look again for that elusive strait to the Far East, the Northwest Passage. Following the west Greenland coast north, John Ross squeezed his two ships, the sloop *Isabella* and the brig *Alexander*, through the Middle Pack, the massive ice belt north of Disko Island. On August 8, 1818, as Ross made his ships fast to the floe edge, not far from today's southernmost Polar Eskimo settlement, Savigsivik, he spotted men on the ice. The Polar Eskimo had been discovered.

To lure them closer, Ross ordered presents put on the ice. (He had come well prepared: his supply of gifts for natives of the high Arctic included 15 pounds of vermilion paint, 102 pounds of snuff, 13 cases of cowrie shells, and 40 umbrellas.) Ross and his officers—in full-dress naval uniforms, with cocked hats, ceremonial swords, and gold-glittering epaulets—walked across the ice to meet them.

Ross's interpreter, an Eskimo from South Greenland who had spent some time in England, found he could understand the Polar Eskimo fairly well. They were, naturally enough, horrified by the ships and thought they were alive, a giant race of birds. "We have seen them move their wings [sails]," they told him. They expressed extreme terror and amazement. "Do you come from the moon?" they asked.

Ross found that Eskimo tools and hunting equipment were simple. Driftwood was scarce and most sleds, harpoon shafts, and lance handles were made of bone or the ivory of narwhal and walrus tusks. But to Ross's surprise, they had iron knives, and their harpoons and lances were tipped with iron that came from huge meteorites nearby. In 1897, Peary brought one of these meteorites, weighing nearly 100 tons, to The American Museum of Natural History in New York. The name of the present settlement

of Savigsivik means "the place where one gets iron."

After Ross, meetings with whites became frequent. Whalers arrived so regularly that the Polar Eskimo called them *upernagdlit*, "the bringers of spring." Occasionally, such contacts had fatal results. In 1830, whalers discovered a camp of corpses near Savigsivik, a whole population apparently wiped out by disease from the outsiders. In 1855, the American explorer Elisha Kent Kane estimated the total Polar Eskimo population at 140; when Isaac Israel Hayes counted them in 1861, only 100 were left. "Their villages . . . rarely consist of more than one hut and the largest village of but three." In 1873, Dr. Bessels, scientist on the Charles Francis Hall expedition, noted that there were 112 Polar Eskimo. But between the time of Hayes and Bessels, Polar Eskimo numbers had been augmented by immigration.

About 1860, famine struck the Eskimo of the Admiralty Inlet region of northern Baffin Island. In vain the men hunted for seal. The caribou seemed to have vanished. Then the great shaman Kritlaq announced that in a vision he had seen people, far to the north, living in a region rich in game. "Let us go there," he said. (If one does not believe in visions, one may assume Kritlaq had heard of the Polar Eskimo from Scottish whalers, who in those days visited both the Thule and north Baffin regions.) They traveled north for four years, stopping in summer in good hunting areas, sledging on in winter. Eskimo legend tells of the old shaman leading his people through the polar night, an aureole of flames surrounding his head. As proof, the Thule people point out that his descendants are often bald, something exceedingly rare among Eskimo. They reached the Thule district about 1864 and were, on the whole, well received and honored for they brought gifts of great value: the kayak; the bow and arrow; and the leister, a three-pronged fishing spear—things the Polar Eskimo had forgotten centuries before. Many of Thule's most famous hunters and travelers claim descent from these members of the last of the great Eskimo migrations.

Peary's nearly twenty-year association with the Polar Eskimo left them dependent upon imported goods, particularly guns and ammunition. In 1910, one year after Peary's final departure, the brilliant Danish (Greenland-born) ethnologist Knud Rasmussen, together with Peter Freuchen, set up a trading station near the gable-shaped mountain called Umanak and called it Thule, the ancient Greek name for the outward bound of the habitable world. Rasmussen set up the post for three main reasons: to supply the Polar Eskimo with goods upon which they had become dependent; to save this region for Denmark since it was then, legally, *terra nullius* (it did not come under Danish rule until 1937); and to use as a base from which to study the Polar Eskimo and lead expeditions into other arctic regions, financed, in part, from the profits of the fur trading. On the Fifth Thule Expedition (1921-1924) he traveled, mostly by dog team, from Greenland to Alaska, with a detour into Siberia.

In 1951, Thule was still extremely isolated, usually visited by only one ship a year. Then, with breathtaking suddenness, the United States built, just across from the little sod houses, a billion-dollar air base. To the Eskimo it was part miracle, part nightmare. Some who had been hunting far to the north during summer and fall found upon their return in early winter a sprawling military town upon the spot they used to call *Pitufiq*, "the place where one leaves boats."

The Thule Eskimo numbered

After hand harpooning a narwhal, a hunter maneuvers his kayak into position to tow the prized catch ashore.

302 in 1951. Now they were joined by thousands (more than 10,000 at one time) of U.S. servicemen. It is to the credit of American and Danish authorities that this massive confrontation did not doom the Polar Eskimo. The Americans and their Danish civilian employees were confined to the base area, and the Eskimo were not allowed to enter it. Two years later, the Eskimo moved away from the noisy air base and settled 120 miles farther north at Kanâk.

In the twenty years since then, their population doubled, reaching 610 in 1971. There is a danger that this number is close to the maximum that local game resources can support. The Danish doctor preaches birth control (with IUDs), and the Eskimo have readily accepted the idea. The results are already evident. There were thirty-four births in 1969, only six in 1970. The Polar Eskimo, still living primarily on their traditional meat and blubber diet (raw or cooked), are the healthiest people in Greenland, says the doctor. Among the most successful of the roughly one hundred full-time hunters, seventeen are in their sixties and six in their seventies. All hunters have to be fairly productive, not just to feed themselves and their families, but to feed the Thule district's approximately 1,200 sled dogs, who devour about 400,000 pounds of meat and 100,000 pounds of fat annually.

The Eskimo do not really need that many dogs. From the strictly utilitarian consideration of pulling efficiency, eight to twelve dogs, driven fan hitch, make an ideal team. But a bigger team is showy, and the young hunters like that. Some have twenty dogs.

In spring, most Eskimo travel to the floe edge to hunt seal and narwhal. I usually accompany Masautsiaq and his wife, Sofie. Masautsiaq is the son (really the stepson, but the Eskimo rarely use this term) of Odaq—once considered the best hunter in the Thule district—who had accompanied Peary to the Pole. Masautsiaq is small, but very strong and agile, gentle, polite, and good natured. He listens quietly, with an indulgent smile, as Sofie, who loves to gossip, tells me slightly malicious tales about some of her neighbors. Masautsiaq prefers to talk about the "old days"—famines, feasts, and great travels are his most vivid memories. "One spring, hunting was bad and for a long time we had nothing to eat but rabbit excrement dipped in seal oil," he recalls.

At the beginning of each month, most Eskimo try to be in the settlement to collect their liquor ration, brought in by supply ships from Denmark. Excessive liquor consumption is a severe problem throughout the Arctic. Thule's Eskimo legislators (members of the *Kommuneråd*, or district council, composed of elected representatives from the six Polar Eskimo settlements and empowered to pass locally applicable ordinances) decided some years ago to give each adult district resident (Eskimo, Dane, or visitor) a liquor book with thirty monthly points, entitling him to buy thirty bottles of beer or one bottle of whisky and eight bottles of beer. In theory, this should be stretched over a month. In practice, most of the town goes on a tremendous toot on the first day of every month and is somewhat hung over on the second. Twenty-eight days of absolute sobriety follow. Some Eskimo belong to the *blå kors* ("blue cross"), a sort of Arctic A.A. and don't touch liquor. But they are a minority.

May is the month in which confirmation takes place. The children are dressed in the finest furs: the boys wear white hooded jackets called *anoraks*; the girls, scarlet. Pastor Mørch, a south Greenlander (to the Polar Eskimo, all other people are "southerners"), wears the black, ankle-length gown and broad white ruff of Danish clergy. The Eskimo like him, not only because he is a fine man but because he has his own dog team and is a first-rate hunter. The service opens with the Eskimo version of Luther's great hymn "Ein' feste Burg ist unser Gott."

After the service, the parents of the confirmed children provide daylong feasts. The locally employed Eskimo—who work as clerks, truck drivers, nurses, mechanics, or laborers—offer, as presents, the best money can buy in Kanâk: fancy cakes, candy, figs from Greece and dates from Iraq, unlimited coffee, tea, cigarettes (which cost $1.15 a pack), and cigars. But their guests' visits are short, polite, and perfunctory. It is at the homes of the hunters that the crowds gather (and that the highest prestige of the day is garnered) to eat the real treats: *mattak*, or raw narwhal skin, crunchy and hazel-nut flavored (and containing 31.8 milligrams of vitamin C per 100 grams of skin); *iterssoraq*, or year-old narwhal tail slowly fermented in a blubber-lined rock cache, the skin bright green, the blubber olive green, the meat black, greenishly marbled, with the taste of the different parts ranging roughly from Brie, to Roquefort, to strong Stilton; and, most loved by all, *kiviaq*, or unplucked dovekies (seabirds), placed into a blubber-lined sealskin bag to ferment for a year, until they have the pungent smell and flavor of old Gorgonzola.

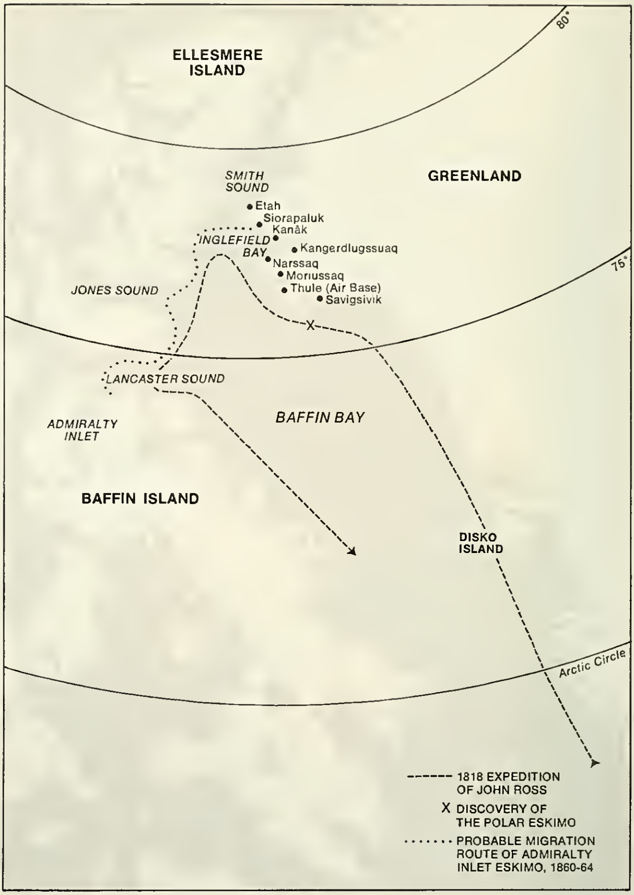
May, in the Polar Eskimo dialect, is called *agpaliarssuit tikiarfiat*, "the dovekies return." By tradition, they are supposed to arrive on May 8. In 1971, they are three days late. The news is sent by radio to all six settlements. There are several colonies, each has millions of dovekies, but only those close to the settlements of Siorapaluk in the north and Savigsivik in the south are exploited.

The dovekies nest in the glacial scree of mountain slopes, the rocks covered with the bright orange, nitrophilous lichen *Caloplaca elegans*, which the Eskimo, less elegantly, call *sunain anak*, "the sun's excrement." Men and women hide among the rocks and scoop the low-flying dovekies out of the air with their *ipus*, or long-handled nets. A skillful catcher can net about 300 birds a day. In 1854, Kane noted

The Polar Eskimo live primarily on the meat and blubber obtained from marine mammals such as the white whale.

that a boy, using a narwhal tusk as handle for a net made of sealskin thong, could catch "in a few minutes . . . as many as he could carry." The handle is now made of wood (occasionally bamboo) and the net of nylon, but catching places and techniques have not changed. The total annual catch, including chicks taken from among the rocks in the autumn, probably exceeds 200,000. Most of the birds are eaten either raw or boiled. Surplus is turned into *kiviaq*.

In Siorapaluk I live with Inuterssuaq (brother of Peter Freuchen's wife, Navarana) and his wife, Naduq. On the walls of his small, one-room house hang citations he has received, together with two medals from the king of Denmark. Every nook and cranny is full of magazines, clippings, and books. (Inuterssuaq has never gone to school; he is entirely self-educated.) Naduq is a traditional Eskimo housewife, an excellent seamstress and hunter. Sixty-two years old, not quite five feet tall, with a slim, boyish figure and a deeply wrinkled face, she clambers with catlike agility up and down the steep, treacherous rock slopes, catching dovekies and lugging them home in bags that are probably half her weight. She is also an expert at making cat's cradle figures with string. Some figures, like "copulation," are risqué. The usually grave Inuterssuaq eggs her on, and she makes them, but is embarrassed. I tell Inuterssuaq that the western Eskimo know a figure called *kalifaiciaq* (it represents the mammoth, and it has always intrigued me that the memory of this long-extinct animal should have survived, perhaps 10,000 years or more, in this Eskimo game). "We know it too." Inuterssuaq says. "We call it *kilifagssuk*." Naduq makes the figure. It is identical to that made by the Copper Eskimo, 3,000 miles to the west. "What is a *kilifagssuk?*" I ask Inuterssuaq. "It means an animal," he explains, "a very big animal. It has four legs. It is like a musk ox but much bigger. It existed a long time ago. But no one here has ever seen it. Even the oldest people have never seen it."


ELLESMERE ISLAND
80°
SMITH SOUND
GREENLAND
Etah
Siorapaluk
Kanâk
INGLEFIELD BAY
Kangerdlugssuaq
Narssaq
Moriussaq
Thule (Air Base)
Savigsivik
JONES SOUND
75°
X
LANCASTER SOUND
ADMIRALTY INLET
BAFFIN BAY
BAFFIN ISLAND
DISKO ISLAND
Arctic Circle
------ 1818 EXPEDITION OF JOHN ROSS
X DISCOVERY OF THE POLAR ESKIMO
.... PROBABLE MIGRATION ROUTE OF ADMIRALTY INLET ESKIMO, 1860-64

Inuterssuaq loves to tell about the past. Every evening he begins: "*Aglani, aglani, aglani,*"—"long, long ago," and the sessions often last until the early hours of the morning. But he is mainly preoccupied with the present and the future. As one of the members of the Thule Council, he has been instrumental in passing legislation to enhance hunting success while preserving the wildlife upon which this success depends. Motor toboggans, now nearly universally used by Eskimo in Canada and Alaska, were outlawed: too expensive, too noisy, and likely to scare game. Char may not be netted in rivers or near river mouths. Eider ducks must not be shot near their nesting colonies. Eider duck eggs and down may only be collected at the beginning of the season so the ducks can lay a second clutch. (Inuterssuaq and Naduq collected nearly 1,000 eider duck eggs on Littleton Island near Etah in 1971. Some were preserved hard-boiled; others were poured into seal intestines or into the gullet skins of glaucous gulls and then sun dried.)

Boats with outboard motors are banned from all the fjords where narwhal and white whale congregate in summer. The people can use their roomy, decked, diesel-powered cutters (which the Eskimo, in imitation of the motor noise, call *tookeetook*) to transport their families and kayaks to hunting camps in the fjords, but they may not be used for hunting. The heads of some fjords are closed to all motor-driven boats; only people in kayaks and rowing boats may go there. Narwhal must be harpooned first, then killed by shooting or with lances, to avoid loss. The minutes of the council meetings show that its members concern themselves with a wide range of subjects, but the dominant theme and preoccupation is hunting success and game preservation.

Although Inuterssuaq enthusiastically explains all that is being done to perpetuate this still-thriving hunting culture, there is a note of sadness in the telling.

"The young don't want to become hunters," he says. Of the entire 1971 graduating class of the fifth-grade school in Kanâk, only two boys say they plan to become hunters. In 1970, only one boy opted for the hunting life. Yet the number of jobs available in the Thule district is limited, and all positions (there are about fifteen) are filled, mostly by young people, who work as mechanics and laborers for the government or as clerks in the government-run store. So those who do not want to become hunters will have to leave: for south Greenland, which has its own employment problems, or for Denmark where, despite all good will, most of them feel alien and homesick.

Minnik, a respected hunter, in a letter to the Thule newspaper, *Hainang* (published twice monthly in Eskimo and Danish for the last thirty-five years), accuses the school of alienating the children. The government school (with both Danish teachers who speak some Eskimo and Greenlandic teachers who speak fluent Eskimo), he writes, educates the young away from the ways of their parents, away from the land, away from their traditional life. They are taught European values and European culture, both alien to the Eskimo, Minnik complains. The teachers reply, in the same issue, that they do everything to avoid this alienation, that the theory of hunting is taught to the boys (by an old, experienced Polar Eskimo hunter), skin preparation and utilization to the girls (by a Kanâk woman who is the wife of a hunter), and that Kanâk students have the longest holidays of any Greenland children so they can spend as much time as possible hunting with their parents.

The conflict of cultures shows itself in other ways. Only two miles east of Kanâk is the once-popular narwhal hunting camp Inerssussat. Masautsiaq and Sofie live there in summers, along with Sofie's brother Jes Qujaukitsoq. Before the ice breaks up in mid-July and the narwhal come, life is rather lean. We live primarily on sculpin—big-headed, bony little fish, caught from ice floes near shore. Jes has had bad luck during the spring hunt and has no food for his dogs. He is also short of money. He is the first to get a narwhal and, helped by other hunters (this automatically entitles them to a share), hauls it in triumph back to shore. And then the hordes arrive. Nearly every wage-employed Eskimo from Kanâk—and his family—comes running to claim a share. They strip the skin off the whale (about 200 pounds, which Jes could have sold for fifty-two cents a pound at the local store) and depart with chunks of meat of varying sizes. Meat from a newly caught animal is traditionally shared. That is Eskimo custom. But wages are never shared. That is European custom. And thus Inerssussat, one of the best hunting spots, is slowly being abandoned. The hunters move to camps farther away, inhabited only by other hunters. Sharing there is mutual and stays within the cultural context.

An old man lives at Inerssussat. At seventy-five, Inuteq is still a great traveler and has a splendid dog team. But his eyesight is failing, and his wife, Aleqasinguaq, a crack shot, does most of the hunting for him, a fact that shames him deeply. He gets quite brusque with me when I tactlessly mention it one day. He has arrived at camp with two three-quarter-inch planks, and using a knife, saw, and plane he transforms them gradually into a beautifully made kayak skeleton. Not a nail or screw is used in the construction. End pieces are doweled, other sections are meticulously tied to make the craft both strong and flexible. One day the saw slips and rips through the palm of his hand. Inuteq stuffs a handkerchief into the deep, jagged gash, walks to Kanâk, has it stitched and bandaged by the doctor, walks back, and continues to work on the kayak. He doesn't even say "ouch."

The kayak is for his grandson, Aron Duneq. Aron is a handsome man and a fine hunter. On July 10, when the ice was so underwashed and rotten that one risked falling through at every step, he ventured far out into Inglefield Bay and harpooned the biggest narwhal of the season.

He is restless and travels far, stays at one camp for a while, then moves on or travels on the cutter of his best friend, Peter Peary, grandson of the explorer. When I meet him in August at Kangerdlugssuaq, a camp in Inglefield Bay where I live with his parents, Aron asks me, only half-jokingly, whether I can't get him a nice Eskimo wife from Canada. (He has, in fact, already sledged to the Canadian Eskimo settlement of Grise Fiord on Ellesmere Island.) Aron is twenty-six, and he is not yet married. In the past, he would have been the beau ideal of every Polar Eskimo girl: a hunter so skilled and courageous he belongs among that elite group called "the large-handed men," meaning he can provide not only for himself and his family but also for many others, less skillful. But today the man of a Thule belle's dreams is more likely to be a Danish plumber. Several young Polar Eskimo hunters, especially from Savigsivik, have made the long sledge journey to the Upernavik district of Greenland to try and find wives there in the most isolated settlements, wives willing to share a hunter's life.

Thus within a generation or two the Polar Eskimo hunting culture may die slowly through attrition. Or the outside world of technology may finally engulf it. Recently, a major oil discovery was made on Ellesmere Island, just west of Thule. Two mining companies are planning explorations on Peary Land, north of Thule. "Nec sit terris Ultima Thule"—and no longer will Thule be the farthest of lands (Seneca, *Medea*). ☐

New Zealand's Mountains: A Majestic Accident

The force beneath the snowy peaks and crags of the Southern Alps is only a passing event in the grand process of the earth's movements

by Christopher H. Scholz

Mountain ranges are among the most visible evidence of the earth's dynamics. Geologists have long known that ranges are built up, not by gradual movements, but by relatively short pulses of intense deformation and uplift. These occur most commonly at existing or former continental margins and may last only a few tens of millions of years.

All of the present, more rugged ranges were formed within the past 100 million years, less than 3 percent of the earth's age. Recent developments in the theory of continental drift have provided a logical explanation for the existence of most mountain ranges. As the theory is envisioned, the earth's strong surface layers, or lithosphere, have broken into a number of large plates that are drifting in different directions. The plates diverge at the mid-oceanic ridges, and upwelling magma forms a new sea floor. The old floor moves out laterally and is eventually destroyed as it is thrust back down into the earth's mantle at deep-sea trenches. In this process continents ride as passively as passengers on a conveyor belt.

The behavior of the lithospheric plates is similar to that of drifting ice floes in arctic waters. Where floes diverge, leads form and water wells up, freezing to the floes and producing new floe ice. The formation of pressure ridges where floes converge is analogous to the development of mountain ranges where lithospheric plates converge.

As a result of lithospheric movement, mountains are ordinarily created through two different processes that lead to distinctly different types of mountains. Where oceanic lithosphere converges on continental lithosphere, a type of mountain range arises that I call the Andean type, after the Andes of South America. In this process the denser oceanic lithosphere is thrust into the mantle beneath the continent and partially melts, generating magmas that produce andesitic and basaltic volcanism. The resultant mountain range develops when the converging plates compress and uplift the accumulation of volcanic rock. The Cascades of the Pacific Northwest are another example of a range formed in this way. In older ranges of this type, such as the Sierra Nevada range of California and Nevada, erosion has exposed their igneous cores.

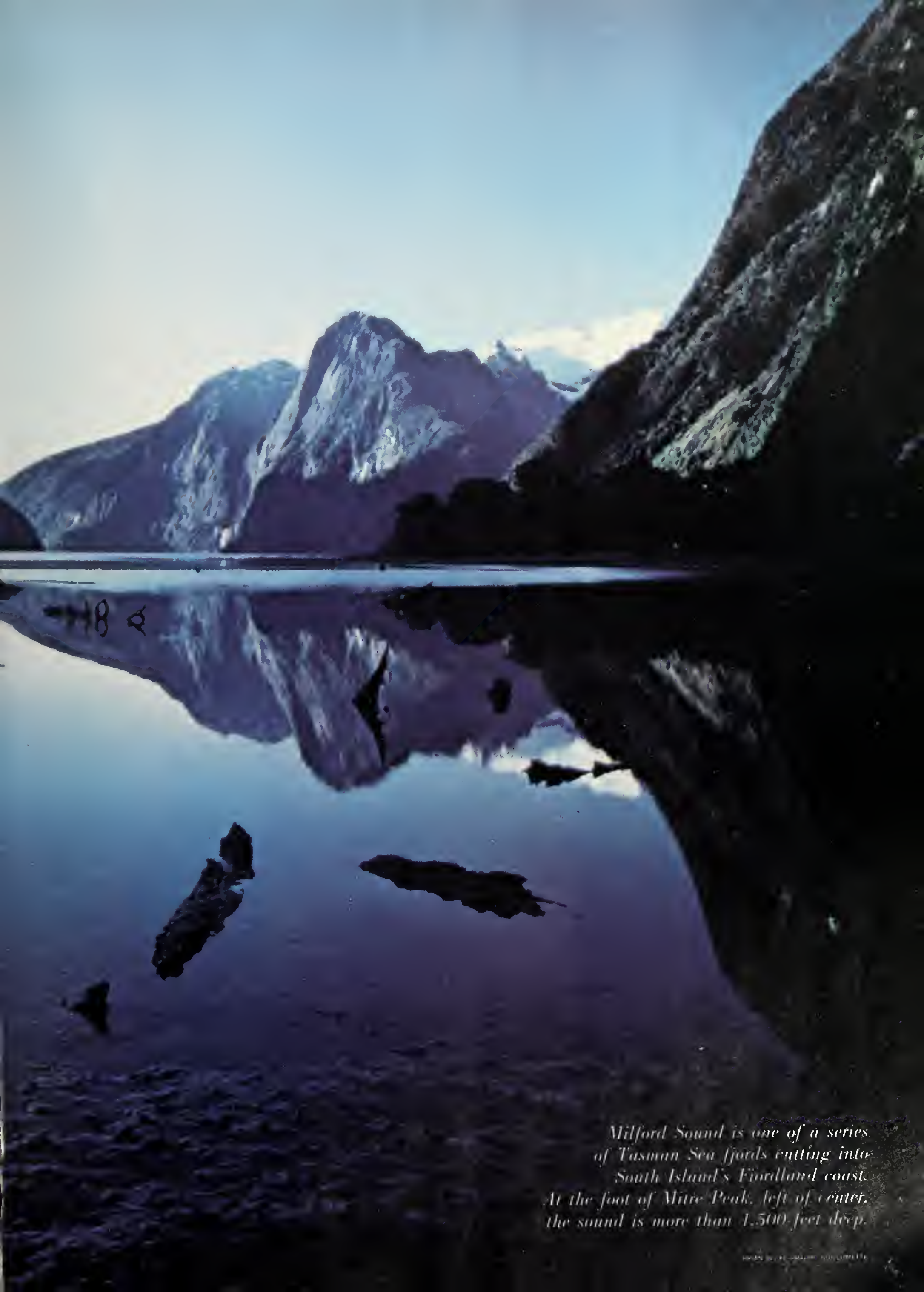
Where two continents collide, neither can be underthrust because of their buoyancy, and much greater compressive forces are generated. Great wedges of highly deformed crust and upper mantle are thrust up, but there is little volcanic activity. Examples of alpine type mountain ranges formed in this way are the Himalayas and the European Alps, which were created when the northward-drifting continents of India and Africa collided with Eurasia. Unlike the Andean type, the alpine-type ranges are not built up on a core of volcanic rock, but consist of upthrust sedimentary and metamorphic rocks of continents. Other mountain ranges, such as the Appalachians and the Caledonides of Norway and the British Isles, resulted from a combination of these two processes.

But the Southern Alps of New Zealand, which experienced a sudden growth in the past fifteen million years, cannot be explained by the convergence of oceanic and continental lithospheres or by the collision of two continents.

By global standards the Southern Alps are not a major mountain range. They are only about two hundred miles long by thirty miles wide, and their highest peak, Mount Cook, is only 12,349 feet in elevation. Nevertheless, they are an

Owing to different mountain-building processes, North Island is dominated by volcanoes, whereas South Island has none. Mount Egmont, foreground, has been inactive for 400 years.

BRIAN BLAKE—RAPHO GUILLUMETTE



Milford Sound is one of a series of Tasman Sea fjords cutting into South Island's Fiordland coast. At the foot of Mitre Peak, left of center, the sound is more than 1,500 feet deep.

[illegible]

BILL BELKNAP—RAPHO GUILLUMETTE

BRIAN BLAKE—RAPHO GUILLUMETTE

Because of extensive precipitation, the Southern Alps are highly glaciated. The Tasman Glacier, left, longest in the range, flows for fifteen miles.

The highest peak in the Southern Alps, Mount Cook stands almost 12,500 feet above South Island's sheep-raising country, which reaches eastward from the mountains.

extremely rugged range, in part because of their youth and their intense glaciation. Running northwest along the western side of South Island, they are the dominant topographic feature of New Zealand.

All along the Southern Alps are landforms resulting from current glaciation. Although most of the glaciers are now retreating several feet a year, the main divide is still covered with thick, permanent snowfields, and glaciers such as the Fox, the Tasman, and the Franz Josef are among the most spectacular temperate zone glaciers in the world. Fiordland, in the southwestern part of the island, is cut by deep, U-shaped valleys that rival Yosemite in scenic splendor. The Fiordland coast is incised by deep, glacier-cut fjords. The northernmost of these, Milford Sound, is one mile wide and has a water depth of 1,500 feet and walls that rise nearly vertically to peaks more than 5,000 feet high.

The west coast of South Island north of Fiordland consists of a narrow strip of lowland bounded by the Tasman Sea on the west and the Southern Alps to the east. The western escarpment of the Southern Alps runs in a nearly straight, abruptly vertical line; in just a few miles, the elevation increases about 10,000 feet. This produces a very strong gradient in ecologic zones. The thick, subtropical bush of the west coast blends almost directly into the arctic conditions of the Southern Alps. Franz Josef Glacier, only nine miles long, descends from the Alps to within 600 feet of sea level and ends within a mile of the bush. In contrast, the eastern slope of the Alps is much more gradual.

The Alps play an important role in the weather patterns of South Island. Cyclonic storms from the northwest off the Tasman Sea produce the major weather patterns. The Southern Alps act as a weather barrier, so that the annual precipitation on the west coast ranges from 200 to 300 inches, whereas the Canterbury and North Otago plains in the shadow of the Alps to the east receive only about ten inches.

The steep western escarpment of the Alps begins directly at the Alpine fault, a major geologic fault that runs the length of South Island. The history of the Southern Alps is inextricably interwoven with the history of the Alpine fault. As a seismologist I wanted to understand why earthquakes occur at this fault and what are the responsible forces.

Geologists and seismologists have often compared the Alpine fault with the San Andreas fault of California, and, in general, the two are similar. The Alpine fault system, which includes the Alpine fault and several associated secondary faults, runs almost 500 miles in a nearly straight line on land. Rocks on the west side of the fault can be matched with rocks on the east side 300 miles to the south, which testifies to at least 300 miles of horizontal slip, a comparable amount to that observed on the San Andreas fault. In both the San Andreas and the Alpine faults, the west side moves northward with respect to the east side.

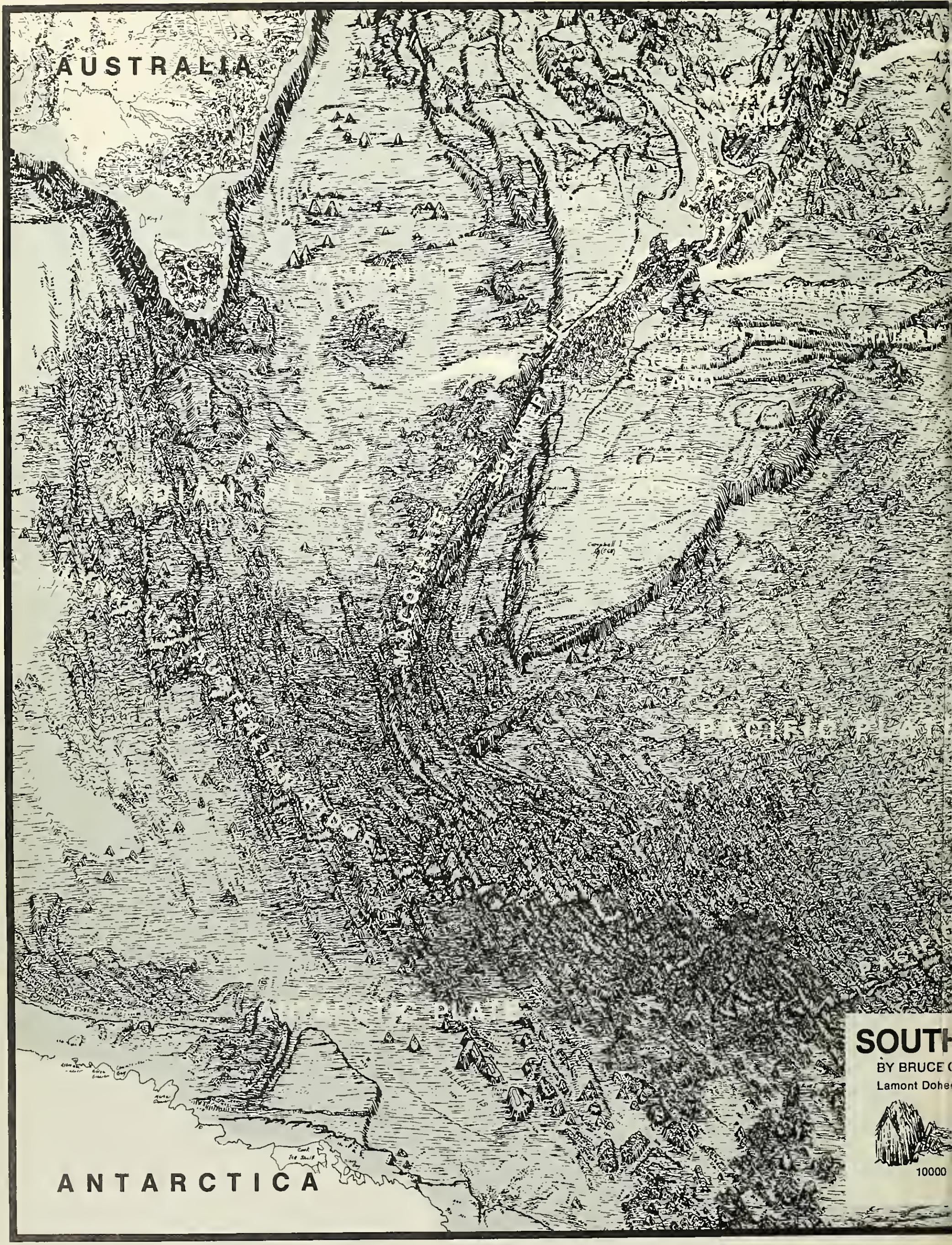
In contrast to the San Andreas fault, however, there have been no great earthquakes on the Alpine fault in historic times. The historic period in New Zealand dates from about 1830, when substantial colonization began. Since that time, there have been a number of very large earthquakes in New Zealand, many of them associated with the secondary faults of the Alpine fault system, but none on the Alpine fault itself. Since most of this part of the country is very sparsely populated, these earthquakes have caused little damage, although a large earthquake in 1855 did considerable damage to Wellington, the capital, which at the time was only a small town.

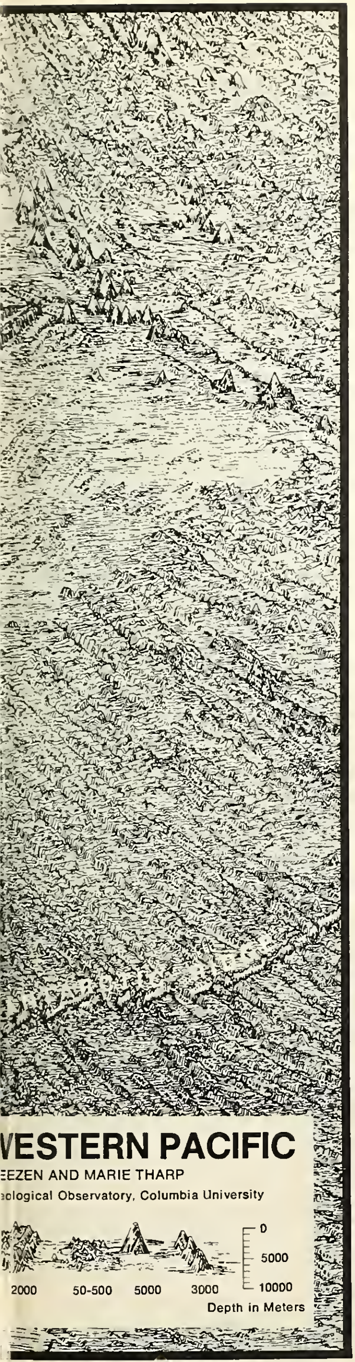
During the same period of time, two great earthquakes have occurred along the San Andreas fault: one in 1857, which produced some thirty feet of slip on a 200-mile-long segment of the fault northeast of Los Angeles; and the San Francisco earthquake of 1906, which produced a slip of about twenty feet on the section of the fault between Cape Mendocino and the town of Gilroy south of San Francisco, a distance of 250 miles. In the same period of time, then, over half the total length of the San Andreas fault has ruptured during great earthquakes, compared to total quiescence on the Alpine fault.

This quiescence is particularly noticeable on the section of the fault that bounds the western escarpment of the Southern Alps; there, even moderate-sized earthquakes are unknown. Studies have shown, however, that the Alpine fault has been far from inactive in the geologically recent past. Where the fault crosses major rivers, such as the Maruia River in northern South Island, the old riverbeds are offset, showing both horizontal and vertical movements since the last glacial period.

Along the front of the Alps, vertical movements are more noticeable. Glacial deposits formed at the time of the last glacial period have been uplifted by 500 feet on the eastern side of the fault. This indicates an average rate of uplift of about one-half inch per year. These observations suggest that the Southern Alps themselves have risen because of vertical uplift on the Alpine fault. The minerals present in the rocks of the Alps nearest the fault indicate that they were once buried to a depth of fifteen miles.

The idea that the Southern Alps have been uplifted on the Alpine fault by this amount, twice the height of Mount Everest, is attractive because it would explain the


AUSTRALIA
Campbell I
BALLENY IS
Cook Ice Shelf
ANTARCTICA
SOUTH
BY BRUCE C
Lamont Doher
10000



steep western escarpment of the Alps and its close association with the Alpine fault. The bothersome question is why this should occur. A similar high mountain range has not developed next to the San Andreas fault in California.

To fully comprehend the role of the Alpine fault in forming present-day New Zealand, the over-all evolution of the southwest Pacific region must first be understood. In the past several years, marine geophysicists working from research vessels have surveyed the magnetic stripes on the sea floor surrounding New Zealand.

As upwelled magma from mid-ocean ridges solidifies and cools during sea-floor spreading, the magnetic minerals in the lavas become magnetized in the direction of the earth's magnetic field. It is now known that the earth's field reverses its direction every few million years, and the ocean floor is thus comprised of stripes of rock of opposite directions of magnetization. This magnetic tape recording can be used to unravel the history of sea-floor spreading.

To the north and south of the Southern Alps, the Pacific and Indian plates are thrusting beneath the denser continental mass that forms New Zealand. Where continental mass appears on both sides of the Alpine fault, equal density precludes underthrusting, and convergence can only be accommodated by upthrusting, resulting in the formation of the Southern Alps. (A portion of the physiographic diagram of the southwestern Pacific to be published by the Geological Society of America, Boulder, Colorado. Copyright © 1974 by Bruce C. Heezen and Marie Tharp.)

Eighty-five million years ago, the Tasman Sea began to open when the sea floor spread in a great wedge with its apex near New Caledonia. New Zealand was separated from Antarctica by this opening, which ceased about sixty million years ago. Australia, once also connected to Antarctica, began drifting north at this time and continues to do so at the present. The present pattern of sea-floor spreading developed fifteen million years ago with a sudden increase in the rate of spread of three well-defined plates. These are the Antarctic plate, containing Antarctica and its surrounding oceans; the Pacific plate, which includes most of the western Pacific basin; and the Indian plate, which includes the Tasman Sea, Australia, the eastern Indian Ocean, and India. The Pacific plate is separated from the Antarctic plate by the northward spreading Pacific–Antarctic ridge. Similarly, the spreading of the Antarctic–Australian ridge separates the Antarctic plate from the Indian plate, which is moving northward.

The edges of these three plates meet at a point 1,000 miles south of New Zealand. The boundary between the Indian and Pacific plates runs north from this point and passes through New Zealand; the boundary south of New Zealand is marked by the Macquarie Rise, the northern part of which is a deep-sea trench produced by underthrusting of the Tasman Sea beneath the Pacific plate. Another trench lies north of New Zealand, runs along the east coast of North Island, and continues north to the Tonga Islands. This trench is marked by underthrusting in the opposite direction—the Pacific plate is plunging beneath the Indian plate. In New Zealand, the plate boundary is the Alpine fault.

The rate of movement between the Indian and Pacific plates in New Zealand, as deduced from rates of sea-floor spreading, is about two inches per year. This amount of movement must be released by earthquakes on the Alpine fault. Since there have been no large earthquakes on the Alpine fault in 150 years, a slip potential of 300 inches, or twenty-five feet, must now be stored up as energy, ready to be released as an earthquake. This amount of slip would result in a very large earthquake, indeed; hence the earthquake hazard may be very high in this region. When this slip occurs, either it will be a horizontal slip, as in the San Andreas fault or, if the theory of the uplift of the Southern Alps is correct, it will produce a sudden uplift of the mountains by as much as twenty-five feet.

In order to investigate these theories, I led field expeditions to South Island in 1972 and 1973, in an attempt to determine the present forces acting on the Alpine fault and to see if the Southern Alps were being uplifted by movement on the fault. We took advantage of the fact that in any earthquake-prone region, small earthquakes take place much more frequently than large ones; and the smaller the earthquake, the more frequent the occurrence. To detect these microearthquakes, seismologists use portable seismographs, instruments so sensitive that they can detect an earthquake with a fault length of only three feet at a distance of twenty miles. These small events occur as frequently as five or ten times a day.

Microearthquakes are caused by the same forces that cause larger earthquakes, so that by setting out our seismographs as listening posts in remote localities, we could gather as much information from the microearthquakes in a few months as we could by studying the much less frequent larger earthquakes for many years. By analyzing the seismograms we could determine not only the locations of the microearthquakes but also the direction of the forces that caused them.

During a three-month period in 1972 we detected more than 400 microearthquakes associated with the Alpine fault system. Analyses of these events produced a consistent result. The Indian plate is definitely striking obliquely on the Alpine fault, producing uplift of the Southern Alps on it. Microearthquakes beneath the Southern Alps are all of normal depths, shallower than ten miles.

In Fiordland, however, microearthquakes occurred as deep down as ninety miles. This indicates that along the Fiordland coast, where the plate boundary continues south of the Alpine fault, the Tasman Sea floor is being thrust down into the earth's mantle much as it is along the Macquarie Rise farther south.

New Zealand is only the emergent part of a much larger continental mass. Deep-sea drilling has shown that the Lord Howe Rise, a narrow oceanic ridge extending 1,500 miles northwest from New Zealand, is composed of thick, buoyant continental crust. East of New Zealand the Chatham Rise, on which the Chatham Islands lie, is also of continental material. Along the west coast of South Island, underthrusting of the Tasman Sea floor changes to upthrusting of the Southern Alps at the point where the Lord Howe Rise connects with New Zealand. South of this point, the Fiordland coast forms a boundary between the dense, thin oceanic lithosphere and the thicker, more buoyant continental lithosphere. There the convergence of the two plates can be accommodated by underthrusting of the oceanic lithosphere. North of this point, however, continental lithosphere exists on both sides of the plate boundary, and the convergence can only be accommodated by upthrusting of the Southern Alps. This situation then, is much like the continental collision that produced the Himalayas, the difference being that here the continents were never separated.

A similar change occurs at the northern end of the range. The Hikurangi trench, which marks the region where the Pacific plate is being thrust under the Indian plate, runs south along the east coast of North Island and stops abruptly at the Chatham Rise. The northern end of the Southern Alps is just opposite this point.

The Southern Alps thus occur where the boundary between the converging Indian and Pacific plates crosses the continental lithosphere. The development of the Southern Alps seems to have begun some fifteen million years ago when the sea floor north of Antarctica began spreading at an increased rate. Up to that time the Alpine fault was probably a simple transcurrent fault, oriented parallel to the slip direction between the two plates so that only horizontal movement occurred on it. At that time it would have been much like the San Andreas fault. As time progressed, the slip direction began to rotate slightly, producing increasing amounts of convergence on the fault and resulting in uplift of the Alps.

The geologic processes occurring along the length of the Alpine fault differ markedly from those of the plate boundary to the north and south. Of particular importance is the lack of volcanic activity along the fault. To the north of South Island, the remelting of the underthrust oceanic lithosphere provides the magma for the volcanic chain that runs through the Taupo volcanic belt of North Island and that is forming the Kermadec and Tonga volcanic islands.

To the south of Fiordland, the volcano that is creating Solander Island results from underthrusting of the Tasman Sea along the northern end of the Macquarie Rise. Volcanism does not occur along the Alpine fault because the lithosphere is not being downthrust into the hot mantle and hence is not melting. This difference in the fundamental geologic processes results in the extreme contrast of the terrains of the two halves of New Zealand, even though both islands are geologically active. The Southern Alps dominate South Island, while North Island contains low ranges broken by isolated lofty volcanoes, and the hot lakes and springs of the Taupo district.

In the grand processes of seafloor spreading and plate movements in the southwest Pacific, the development of the Southern Alps was a minor, even incidental, occurrence. Their presence is the result of the accident of the New Zealand continental mass lying in the path of the Indian–Pacific plate boundary. From our egocentric point of view, such accidents are fortunate, for the Southern Alps are certainly one of the most majestic mountain ranges in the world. ☐

Oscar:
An Inquiry into Madness

In the Caribbean world of contradictory values, what does insanity signify?

by Peter J. Wilson

On the map, the island of Providencia, or Old Providence, appears as a tiny dot in the southwest corner of the Caribbean Sea. But for those who live there, it is the center of the world, the only land in a universe of sea and sky. Its nearest neighbor, San Andrés Island, is just forty-eight miles to the south, but Colombia, its motherland, is almost 500 miles away across an empty sea. As far as Providencia is concerned, Colombia might as well be in another world. Throughout the 150 years of their association, Colombia has more or less ignored Providencia, leaving it to fend for itself.

To the people of Colombia, Providencia and its inhabitants are something of an anomaly, for they are a Protestant, English-speaking mixture of African Negro and European white, whereas the Colombians are a Catholic, Spanish-speaking mixture of white, Indian, and a little African.

Providencia's distance from the mainland and its anomalous cultural makeup have served only to increase its insularity. What is more, the instability of political life on the mainland itself, which has persisted since Colombia gained its independence, has meant that governments have had little time for a small speck of land so far away.

About two thousand people live in the fourteen villages scattered along Providencia's shore. Some are white skinned, tanned to copper, with angular European faces; some are glistening black with the rounded features of the African; and most are a mixture. The historical pattern of their Jamaican English culture has been maintained to the present day, although more and more people are learning Spanish as radios become more common and as more islanders are compelled to seek jobs on the Colombian mainland, rather than in the Panama Canal Zone or the United States, as they did in the past.

Such then, in brief, is the society into which Oscar was born. I first met Oscar on board the MV *Ray*, the ancient vessel that brought me to the island. He rowed out to greet the ship in a dinghy that he had borrowed—much to the owner's chagrin, I later learned—and on seeing me, both a stranger and a white man, immediately introduced himself as Prof. Oscar Bryan de Newball and demanded to know who I was and what brought me to these parts.

Excited and nervous—this being the start of my first anthropological adventure—and groggy from seasickness, I was taken aback by the imperious abruptness of Oscar's approach. After shaking hands and giving him my name, I stood tongue-tied. Fortunately, Oscar quickly moved away to speak to some of the other passengers and crew, asking them for the latest news, for details of the ship's cargo, and whether the ship had behaved well. And all these questions were asked in a loud, authoritarian tone, as if the questioner were nothing less than governor of the island. Shortly after, he disappeared into the wheelhouse, saying he must see the captain about important matters.

A few minutes later, as I was being taken off the boat and ferried ashore, my ferryman explained to me, half apologetically, that I was not to mind, for it was only Oscar, who was mad. Then he quickly added, as if he had given a false impression, that I must also remember that Oscar was very intelligent.

Because Oscar is an extraordinary person, his life is not to be taken as one that is typical of lives in the Caribbean. Yet, to paraphrase Oscar himself, it is only through the study of the extraordinary that we can come to some sort of understanding of the ordinary. In the events of Oscar's life there is, I think, the exaggeration of what passes unnoticed, although not unsuffered, in the lives of ordinary people.

All Caribbean societies have a dual value orientation that originates in their colonial history and persists in their postcolonial situation. Having been dominated and indoctrinated by Euro-American culture, the Caribbean has come to regard this culture, and particularly its values, languages, and institutions, as superior to any values originating in its own societies. I call this complex of metropolitan values "respectability," a term widely used in this sense throughout the English-speaking Caribbean.

Sociologically, respectability is the charter that supports and authenticates a class structure, and those who are considered respectable are those who are considered upper or middle class. Where they exist, expatriates are the arbiters of respectability, but for the most part, the arbiters are natives of the Caribbean.

Respectability is defined through the use and perfection of the language and speech of the metropolitan

Copyright © 1974 by Peter J. Wilson. From Oscar: An Inquiry into the Nature of Sanity, *to be published by Random House, Inc.*

culture—respectable people speak "proper" English, not creole or patois or bush English. Although not mandatory for respectability, a fair skin and Caucasoid facial features are considered highly desirable and esthetically preferable. But if the aspiring respectable person is not so blessed, then he must maintain a standard of dress and conduct and a style of life that are identified with the life of white expatriates or with the metropolis. Life-style is, of course, founded on wealth, but wealth alone cannot confer respectability. It is the manner in which wealth is displayed—in furnishings, housing, and appliances—that confers respectability.

Life-style and manners have a moral side too, and respectability requires worship at a Christian church, properly married spouses living monogamously in a nuclear family household complete with servants, and a publicly firm observance of sexual propriety.

Respectability, then, denotes a way of life and a standard of living, feasible throughout Caribbean societies, but not authentic to it. Its origin is alien and its values misplaced. Respectability, by definition, is exclusive and for the few. Those few consider themselves superior, but since their superiority can be measured only against the apparent inferiority of the majority, it becomes true to say that respectability is gained at the expense of that majority. A population cannot live by negative standards, however, nor can a majority rest content with an inferior social and moral position. Consequently, throughout the Caribbean, including Providencia, there exists an opposing, but politically subordinate, value complex through which individuals can achieve a measure of existential fulfillment and recognition. This, I call "reputation."

Reputation is autochthonous, springing from the adaptation of people to local conditions. It is also a counterculture to respectability and all that respectability stands for. Reputation emphasizes egalitarianism and opposes class hierarchy. It recognizes status differences but does not rank one status above another. It regulates social relations by exercising sanctions intrinsic to the relations themselves rather than by invoking external codes of law. A man's reputation is rooted in his fathering of children, which is the most important demonstration of his maturity and manhood. The honoring of fatherhood by bearing responsibility for it is the heart of a man's good name.

Arising out of this basic value are numerous other qualities that are prized; attaining them contributes to reputation. Among these are a readiness to fight in defense of one's honor and a proficiency in the use of language, notably in sweet talk, riddles, storytelling, punning, boasting, insults, curses—generally being verbally fluent. Closely related to these skills are musical ability and knowledge of local lore.

A man's reputation is relative to that of his peers; there are no absolute standards or abstract criteria of excellence. A man with a reputation for being a good musician is good only with respect to other musicians. He can always be bested by his peers. Nor is a good musician better than, or ranked above, a good fisherman. They are equals in all respects but their particular activities.

Like respectability, reputation incorporates a system of moral evaluation and judgment. All reputations must be earned and bestowed, but all men have some measure of reputation, and it is that measure of reputation that gives them a place and a sense of integrity among other men in a community and in a society.

Between reputation and respectability there is a constant struggle in which authority is validated only through reputation, and power granted only through respectability. No official, for example, can hope to have his orders or requests properly carried out unless he has some positive reputation among those he is commanding. He does, of course, have the power to enforce his orders, but unless he has a reputation, he will have no respect even though he is respectable.

There are many and often subtle ways by which reputation undermines respectability—by noncooperation, by satire, by withholding services, by gossip, by stealing, and by deception. In instances where political and economic problems have come to a head, reputation and respectability have clashed violently. But the main point is that reputation and respectability are in a sense dependent on each other: together, they make up a single system. The nature of this system is that it is dual and contradictory; from birth every individual must accommodate himself to these contradictions, trying either to overcome or to reconcile them.

Just as the relationship between these values in the society is a tense and dialectic one, so their reconciliation by any individual involves tension. And because all individuals must cope with this tension, their lives are touched by contradictory or schizoid circumstances. In living through the situations that shape their lives and make them comprehensible, the people of the Caribbean must become, to varying degrees, schizoid.

I believe that all colonized peoples have lived to some degree with this burden of ambiguity and that it has greatly contributed to the seemingly schizoid nature of the subordinate and oppressed. As far as individuals are concerned, some manage to reconcile themselves—at least to the extent that, simply as persons, not as political and economic subjects, they have been able to pass through life on an even keel. But some are overwhelmed. Those who believe in the rightness of respectability and try to act on that belief, rejecting the realizable goals of reputation in favor of an alien set of values they cannot realistically hope to achieve, are those who, I think, become schizophrenic.

Oscar typifies this situation: the schizoid character of the society in which he lives has become transformed into the schizophrenia of the private individual. Because of this, it is possible to argue that Oscar represents an embodiment of the dilemma of the black man in the white man's world. I hesitate, however, to insist on this. I also hesitate to insist that the schizoid nature of the society is the only cause of Oscar's behavior. Perhaps it might be better to say that the form that Oscar's behavior took is traceable to the tension between respectability and reputation.

I have no intention, however, of attempting any clinical diagnosis of Oscar. What I do want to do is to try and analyze the salient points of relation between the individual, Oscar, and the society, Providencia.

Oscar was an "outside" child—that is, his father was married to a woman other than his mother, who herself was not married. This is a not uncommon situation in the Caribbean, and in the system of reputation it carries no stigma. But it is not respectable. His undeniable intelligence directed his ambitions, which could be realized only in certain culturally directed ways: he could have become a schoolteacher or a church official.

The church has long been the only white-originated (hence respectable) institution in the Caribbean through which poor people like Oscar could legitimately fulfill intellectual ambitions engendered by the respectable society—primarily through its schools. Learning, especially religious learning, is one of the most highly prized achievements of reputation; through learning one can theoretically make the transition from reputation to respectability. Oscar, however, started with three disadvantages—he was black, very poor, and an outside child.

The desire to be better than his father—who was a good handyman, but not schooled—provided the immediate impetus for Oscar's ambition. But the man he sought to emulate was his maternal grandfather, Captain John J. Newball, a "genuine" white man who achieved a notably respectable position. Oscar appears to wish to vindicate his mother's degradation—hence his own—at the hands of his father.

But to be literate or even to become a minister of the church is not enough to achieve full respectability. To do this, a man must negate the moral circumstances of his birth and family relationship. This he can do only by marrying legitimately and achieving manhood as a father—which in the Caribbean means not just begetting children, but also providing for them. In this, Oscar failed miserably. He married because his girlfriend became pregnant and marrying her was the "right" thing to do. Then, when he left the island to train for the ministry, his wife was unfaithful, living with another man during Oscar's absence.

Although his wife bore him five children, Oscar has lost touch with all of them. In his words, "We all fell apart, and they are lost to the wolves of society." Oscar's hopes that he would be able to compensate for an incomplete childhood home were finally destroyed by the breakup of his marriage. His ambition to be the father to his children that his father had never been to him was finally frustrated.

Oscar had been brought up a Baptist, but he chose to pursue his ambitions in the Adventist church. The Adventist church, especially on Providencia, includes far more respectable upper class and white members of the society than any other church, but its closed nature makes it a somewhat elitist institution. From the outset, it was harder for Oscar to move from reputation to respectability through the Adventist church than it would have been through the Baptist or even the Roman Catholic church.

Oscar was certainly invited to the Adventist Training College in Panama. The question is: in what capacity? He seems to think he was invited to study for the ministry, but from what he says, there are also hints that the officials there employed him as a menial. Just what happened during his stay in Panama will never be known. But it was there that he broke down, and I suspect it was there that the impossibility of his ever being able to pass from reputation to respectability became apparent to him.

When what are regarded as the superior people of the superior culture endorse a given mode of aspiration and expression and judge others by it, it is to be expected that those others might measure fulfillment in terms of their success in meeting these expectations. The standards of respectability and its main agent, the church, hold just this place in Caribbean society. But when individuals attempt to meet these standards, they have the right to expect help; and when they achieve the goal, they have the right to recognition. The Caribbean Englishman, however, never becomes an Englishman, and black is never recognized as white by those who recognize each other as white. Having decided on this course, Oscar may have received help, but he seems to have gained no recognition.

But the extraordinary thing to me is that although Oscar was bitter about his past, he turned his life into a positive and, one might also say, triumphant campaign. Having been led on by the ambitions engendered by the dominant values of his culture, and having been let down by the keepers of those values, he became a man rejected emotionally, socially, and culturally. Yet he managed not only to survive but to establish himself in a unique position of dominance, even respect, among the people of Providencia.

Oscar had a reputation that extended beyond the boundaries of Providencia. When I first went to San Andrés and told people there I was going to Providencia, they would tell me to look out for Oscar, and then they would laugh. When I pressed them to tell me more, they said he was a madman, but that he was also very intelligent; that he knew all the history of these parts and he knew his people.

When I got to Providencia I was told about Oscar in the same terms, and as I got to know people they would express their opinions in greater detail. I also had the opportunity to see how people's opinions compared with their actions toward Oscar. The initial ambiguity expressed by San Andresanos and Providencians—that Oscar was both mad and very intelligent—remained unqualified; if anything, the better I got to know people, the greater their ambivalence.

There was no doubt that even the most highly educated islanders had considerable respect for him, even if it was a little begrudging. The simpler, less educated people, while they teased him, remained in some sort of awe of his apparent learning, and not infrequently took to heart his condemnation of their behavior.

On the other side of their attitude, though, was fear. Oscar was frequently described as being evil, and some of the island women would shut themselves in their houses if they knew he was around. Certainly his ability to appear in a doorway without prior warning

was uncanny, and his practice of greasing his feet and stealing noiselessly through a house at night, taking some objects and leaving others "in exchange," lent substance to a sort of supernatural quality that people attributed to him.

This sort of fear, however, was more superstition than substance. The real fear—the one a visitor notices, and that I myself came to experience—goes far deeper and, I think, has far more to do with a condition shared by the entire population, one to which Oscar is related in a rather special way.

I would therefore like to attempt an explanation of this ambivalent attitude of a population toward one of its members, an individual that it terms mad, but for whom it has considerable respect; a person it considers intelligent, but whom it fears. There are two levels at which I wish to offer this discussion: Oscar's use of language and his behavior with respect to privacy.

The Negro people of the Caribbean had the English language forced upon them. But they took it and made it into a language that was not the language of the English people. In early days a white English slaveholder could listen to his slaves speaking English without necessarily understanding what was being said, as slaves frequently meant something other than the obvious signification of the words. The "man of words" became the specialist who fashioned English into a new art form, who made the ambiguities of the language into a language of its own. And language itself was fused with other possibilities of communication—with facial expression, with bodily gesture, with tone of voice, with lip and eye movements, and with posture.

Under conditions where work was slavery, language became one of the means by which work could be transformed into a modicum of entertainment. For a people deprived of time and access to rest and creative outlets, language was both the tool and the material out of which a variegated store of art and culture could be fashioned. Stories, insults, boasts, toasts, poems, allusions, parables, jokes, irony, satire, mimicry, and puns evolved to heights unknown to the speakers of English. When these language arts were joined with music, the art of the Caribbean language emerged.

But the English language in the Caribbean has also been a political instrument. For their own convenience and in support of their own power, white slaveholders forced their slaves to speak English. But without the owner realizing it, the slave took the language and made it his own. And he thus succeeded in isolating himself from the overbearing white culture. The very language that was forced upon him in order to establish a continuity between the races and cultures became instead a vehicle of discontinuity. The means by which the white sought to make the black dependent became the instrument by which the black came to achieve independence. And because it was still the English language, the English never knew what was going on: the language was the veil of deception.

Language in the Caribbean is not simply communication; it is also communication about communication, controlled and developed to an art form. And the man of words is the man who more than any other is the object of his neighbors' esteem. The strength and wit of Oscar's language earned him the respect of his fellowmen: as a practitioner of language, he could claim a positive place in the value system of the society. Oscar was respected because of his reputation, and his reputation rested on words.

Oscar's language is not meant to be a simple act of communication; it is a thing in itself. Not just the words have meaning, but the uttering of the words has meaning. Yet when someone listens to a person speaking, he naturally expects meaning to come from the speaker's words and the context in which they are used. When Oscar speaks, one looks for meaning in what he is saying. And since Oscar uses a religious idiom, one searches for a message as well. But the meaning and the message are not apparent. They have not been conveyed in the form anticipated by the listener who, knowing he has heard English, cannot believe that what he hears has no meaning.

To dismiss what he has heard is to admit his own inadequacy; to accept it is to give it meaning. But one must search constantly for the meaning beyond the actual words. On one level, Oscar is accepted, but much of what he says and stands for is beyond the comprehension of the listener. In this way Oscar isolates himself from the rest, but they remain bound to him by their feeling that although the meaning is beyond them, there is meaning nevertheless.

Language is something that Oscar manufactures or, at least, something he has taken over and refashioned according to his own design. I am not saying he invents words, but that he takes language as a whole and makes it his tool. Since it is speech rather than the written word that he manipulates, it is coterminous with his presence. Oscar and his speech are one and the same; they coexist only as long as he is there. As soon as he stops talking, Oscar becomes a fantasy, ambiguous and amorphous.

This elusiveness is illustrated by, indeed embodied in, his wandering behavior. He never stays in one place for any predictable length of time. He can move in total silence. He will pass soundlessly through a sleeping house or spend the night underneath a house. One knows that he has been there—therefore, that he is—only by the objects he has left behind.

And what of these objects, the ever changing contents of his sack or hat? Sticks, stones, weeds, fish heads. These are natural objects that have no value aside from their relationship to Oscar; it is he who has invested them with meaning. He steals objects that have value to others: clothes, utensils, books. In exchange, Oscar leaves his objects. They have been collected by Oscar, and his leaving them behind indicates that he has been there. He makes his presence even more obvious by arranging sticks or pebbles in the form of a cross, an unnatural object.

These objects, like Oscar's language, are so common to all that they are not thought of as property. But Oscar's use of them reincorporates them into society; he appropriates them and allows them to stand in his stead. However, since they cannot be used by others, they have no value except insofar as they represent Oscar.

The artifacts to which other people attribute value are valueless to Oscar. The artifacts he uses to represent him have only this value to others, but they have considerable value to Oscar. Thus what he has done is to remove himself from the level at which ordinary people reflect value, even though he has retained the same media (language and artifacts) and the same materials they work with. He is not a foreigner whose language and life products are incomprehensible. He is recognizably one of them, yet at the same time beyond them. His behavior is not an alternative to, but rather a denial of, their own. He establishes his isolation from them at the same time that he forces them to recognize their dependence on him. He steals government documents, for example, then offers to find them (but not the thief). He steals objects that people want back, but he does not require that they return the objects he leaves in exchange.

Oscar has succeeded in excluding reciprocity, but while it has led to isolation, it has not severed him from the rest of the people of Providencia. Why and how this is so brings us to the discussion of privacy and Oscar's madness.

The two thousand people of Providencia live no more than about fifteen minutes' walk from each other. For nearly two hundred years they have married and mated with each other, so their claim that all the islanders are "one family" is not too far from the truth. The individuals in this population have a common life situation and a common historical experience—a single cultural memory. The dualism of the value system has not given rise to a dual society, one that is split into two population segments that have structural permanence. Everyone faces the strain of reconciling reputation and respectability, rather than opting for one or the other, and the respectable person cannot guarantee the same status to his heirs.

These common bonds and the resultant exclusiveness make Providencia a closed society. Even though it shares much of its culture with other Caribbean societies, as a living community it is difficult to break into.

Behind the barriers of the closed society, however, is a wide-open way of life. Men conduct their social lives in rum shops or in shady spots on the beach; women work and chat in houses where the doors are always open or they gather in a cool corner of the yard. Houses are close to one another, separated by yards that are often no more than symbolic barriers.

The intimacy that is intrinsic to island life makes privacy a delicate and sensitive commodity. Social life is marked by numerous stratagems and tactics that aim to secure the privacy that the environment inhibits. Wealthy people, for example, build two-story houses and live in the upper story. It is hard to come upon a house by surprise because there is always someone—a child, an old man or woman—sitting by the window, on the veranda, or in the doorway, partly with the express purpose of keeping an eye out for whoever is coming along the road.

It is difficult for anyone to go about his business unobserved, as a hundred pairs of eyes will have watched his progress from one house to another. And since the island is crisscrossed by narrow, overgrown paths along which people (children particularly) run messages, the word of his coming may reach his destination before he does. Gossip and warnings get to communities long before officials and other visitors have made their way over the regular paths.

Since the closed society is so open on the inside, it forces a certain degree of secretiveness and stealth upon all its members. But as soon as anyone gives any hint of behaving secretively, curiosity is kindled, and people will make an effort to find out what is going on. Everyone, at some time or other, may become involved in activities that involve these conflicting notions. One may wish at the same time to do something in private and to find out what someone else is doing. Much behavior is thus marked by these two inclinations straining against each other.

Now, if privacy is more important because it is precarious and difficult to achieve, then any factor or person that adds to the basic and inescapable difficulties of maintaining privacy is a nuisance or even a danger. And like any danger, it is to be avoided, put off, or if possible, placated.

I think that more than anything else, Oscar's relation to the rest of the society is explicable in these terms: he is a real and possibly uncalled-for threat to the everyday privacy of members of the community. At the same time, he is a useful source of news, a revealer of the privacy of others, and in this guise he may be looked upon positively and even tolerated. In some instances it may even pay to encourage his behavior in order to find out what is going on.

There is, then, at many levels, an ambiguous attitude toward Oscar, stemming from the ambiguity that is inherent in the restrictions on privacy. When, for example, Oscar revealed an islander's incestuous relationship with his daughter, the crowd's reaction was ambivalent. To appear interested and to encourage Oscar would be to condone his behavior. But to ignore what he had to say or to prevent him from saying it would be an unnecessary self-denial.

Then there is the problem of Oscar's credibility. If he gossips about someone else, one is ready to believe him; but should the gossip be about oneself, one is anxious to negate him.

How, then, can people "take" Oscar? Especially if they cannot send him off to an asylum? By calling him "mad," the people of Providencia are able to take away from Oscar the power of sanction: they can decide for themselves whether to believe what he is saying or not. In their eyes, Oscar is not mad all the time; he is sometimes "in" and sometimes "out." Underlying their categorization is the desire to exert some control over his credibility; at the same time they find it useful to accept him and his madness.

In speaking of privacy I do not mean simply the desire of people to be alone. I understand privacy to mean a situation in which a person may be alone with another person or alone by himself, but alone in such a way that his relationship with others is not interrupted. Privacy is the condition by which all social re-

lations are fulfilled; it is not so much a psychological need as a social one. To activate any given relationship, the participants must suspend or disengage from their other relationships, and the other partners in these other relationships must agree to the disengagement.

Privacy, then, is the simultaneous activation of one relationship and disengagement from another. It is, in fact, the basic relation between relationships; without it, no individual can function, since it is through relationships that he achieves his sense of identity. Neither can a social system function, since social relations are its elementary components.

The successful activation of any given relationship requires that those concerned disengage themselves from other persons with whom they enjoy relationships and to whom they are bound. The successful achievement of a relationship and disengagement may be taken as a measure of the authority a person has not only over himself but with respect to others. Some relationships, notably those we regard as intimate, require a greater degree of disengagement from other relationships, and inability to keep others out indicates loss of authority. Conversely, the power of persons can be measured by the extent to which they can prevent those to whom they are related from acting with others. Thus in privacy lie the roots of social power and authority.

Oscar's ability to invade and intrude upon the privacy of others, to intercede in the relationships they seek to pursue, is an indication of the power he exerts over them. In this sense there is something of the tyrant about Oscar. I know from my own experience the extent to which this power can be overwhelming. At times my wife and I were driven to furtiveness in even the most innocent aspects of our relationship, even when we were within the privacy of our island home. The people of Providencia have to live with this day in and day out. A tremendous power lies in the potential to invade privacy; in this case, that power was wielded by Oscar. Like all exercises of power, it generates fear in those who are its objects.

Normally the threat of this power is kept in bounds by the reciprocity of trust, discretion, respect, and honor. But Oscar excludes reciprocity. He does not observe the conventions of trust and honor. One can never know that Oscar will not pass on what he has learned. Such then is the basis of the power he is able to exercise over people, a power that threatens to undermine their authority over themselves.

Oscar himself never engaged in any sustained relationship with other people. It was he who initiated and terminated all contacts. He came to me when he wanted to, and not if I asked him (though he might come if I asked). He told me what he wanted me to hear. He left when he felt like it. He divulged secrets when he saw fit; not when others asked him. He begged or borrowed those objects that he felt he needed, but if no one gave him what he wanted, he would steal it—even though he called it exchange. In other words, he more or less effectively prevented anyone else from exercising any power over him. And he maintained a more or less absolute authority over himself.

Oscar's life was so wholly public that he had no domain of privacy through which other people could strike a balance of power with him. Or to put it another way, his privacy was so complete that no one could gain access to it in order to erode his authority. And yet he remained a social being: he entered into relations with others, but withdrew at will; he could still communicate with others when he chose. And possibly, at least to the barest minimum, he was still beholden to them.

I should perhaps make it clear that I am trying to describe the present situation, the situation in which Oscar exists for others as a madman. But why madness? For that matter, what is madness? In part I would say that it comprises the abrogation of relations with other people that gives rise to such complete authority that they are rendered powerless. The only recourse available to those who are so overwhelmed is to banish such tyranny from their lives—to a hospital, an asylum, any ship of fools. Such banishment is accomplished emotionally and rationally by conferring the label "madness" and depriving the individual of responsibility. Hence, there is no need to recognize him.

Madness, then, is tyranny, and it seems to be in the nature of tyranny that it comes to be madness. Nero, fiddling while Rome burns? Mad! Hitler flying into rages, not listening to his generals? Mad! Senator McCarthy finding communists in every nook and cranny? Mad! The more absolute we see the exercise of power to be, the more our only recourse for regaining authority is to push that power outside the normal frame of reference.

But privacy as I am talking about it here is part of everyone's life and day-to-day behavior. In this nonpolitical sense, Oscar seems to represent, in his person and in his relations with the people of the island, the development to an extreme degree of this tension of privacy. Normally, this tension is well accommodated, but the moment it teeters off course it can begin to pose enormous threats to social life.

The gravity of this threat rests not only in its disruption of social life itself, but also in the distortion of an individual's sense of himself.

The search for identity rests squarely on the freedom of choice we can exercise in entering into and conducting relationships with others. By seeking total divorce from others we can achieve nothing except complete alienation and negation; in fact, as Oscar's story illustrates, the achievement of pure self-autonomy is sheer madness, the denial that one is recognizable by others. Thus the idea of self-control is to be understood as control of oneself with respect to others. Its exercise and achievement must be contingent on the submission and assent of others, as their self-control is dependent on our submission. Let us take this general argument as it applies to privacy.

If I achieve a state of privacy—that is, if I choose the time, place, and person of my relationship—then I am dependent on the willingness of others, to whom I am bound in some way, to leave me alone, to respect my privacy. But suppose they interfere, intrude, interrupt, or even prevent by force my preferred and chosen association? In doing this they prevent me from satisfying myself with respect to the other I have chosen, and by whom I have been chosen. My integrity has been shattered and my freedom usurped. My authority, not only with respect to others but over myself, has been undermined.

Why should others not let me alone? One reason is that they do not trust me. They do not believe that in my chosen relationship I will not pose a threat to their own relations to me and thereby erode their own authority. But in what sense can this be?

Well, if others are as dependent on me for recognition as I am on them, then is not my separation from them in some measure a withdrawal of my recognition, potentially if not actually? If separation requires trust, then in separation there must be grounds for mistrust, for every relationship that a partner undertakes may modify every other relationship in which he is involved. And the more I succeed in keeping others out, the more I enhance my authority while challenging their power by withholding my recognition. Equally, the more susceptible my own relationships are to the interference of others, the greater their measure of power over me and the less my authority.

One can't help suggesting that what we do in the course of everyday life is to strike some sort of balance. But at the same time, thinking of it this way suggests that there must be some limits beyond which trespass can only have the direst consequences. If an individual or a group erects more and more impenetrable barriers to surveillance by others, then the threat to the power of others becomes intolerable, and in an extreme situation, they may be driven to irrational and violent reactions—to witchhunts, inquisitions, and other forms of blind violence. Historically, this has resulted in the darker times that, as we look back, we call mad. Or when the power of those to whom we are bound becomes so irresistible that our privacy shatters about us, then we are driven to conspiracy, secrecy, plotting, anarchy. And madness.

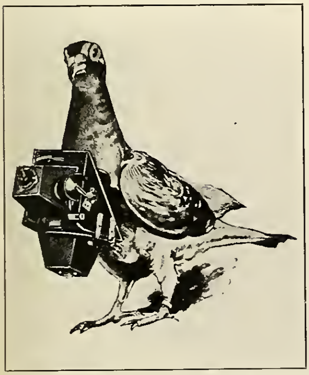
Privacy and surveillance, as many have pointed out, are two sides of the same coin, and each contributes to the existence of the other. There is no need here to enter further into the sociological and political implications of the argument. I am concerned with pointing out that when we call a man mad, we acknowledge that by his behavior he has reached a point beyond our power to control. We submit to him, for he achieves a complete authority over us while we are unable to make even a dent in his self-control. Since we are not willing to admit to impotence or to submit to slavery, the only way out for us—apart from complete annihilation—is to disqualify the threat by calling it madness. It is this situation that the relationship between Oscar and the people of Providencia throws into relief.

By recognizing that they have a relationship with each other, Oscar and the people of the island guard and grant each other their freedom through their privacy, even while they have agreed to give up some of what so-called normal people may reasonably expect of each other. □

The 1974 *Natural History* Magazine Color Photography Competition

If Henry David Thoreau had walked through the natural world of this century, rather than the last, he probably would have been a great nature photographer. He had all the right traits: patience, curiosity, powers of observation, sensitivity to the interrelationships of man and nature, and a natural sense of beauty, order, and timing.

Thoreau also had the luck of the good player. He was once walking with a visitor who asked him how he ever managed to find Indian artifacts. Why, they are everywhere, Thoreau replied . . . and he stooped down and picked up an arrowhead lying beside the path.



The 1974 *Natural History* Magazine Color Photography Competition is for today's Thoreaus, those good players who can find form, beauty, and art in the natural world—and who have photographic talent. With luck, one of those players will be walking along a path at the very instant that a great picture is unfolding. The photograph that emerges from that serendipitous moment will bring fame and fortune to its taker and pleasure to all readers of *Natural History*.

The Competition: We've tried to keep the categories wide. 1. The Natural World. 2. Man and His Environment. 3. A Chronological Sequence, which may be any series of up to five photographs of an event in nature.

The Rules: We've tried to keep them simple. 1. The competition is open to everyone except, of course, employees of The American Museum of Natural History. 2. Competitors may submit up to five, previously unpublished color transparencies in each category. 3. The mount of each color transparency must contain the name and address of the photographer, because keeping track of the thousands of entries is one big job. 4. For each entry we would like to know the make and model of camera, the film rating and the exposure time (if you remember it), and where the picture was taken. 5. Include a self-addressed, stamped envelope, since we will want to return the transparencies to you.

The Closing Date: We've tried to keep it short. All entries should be postmarked no later than April 15, 1974—just like your income tax.

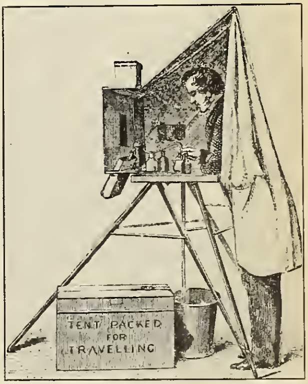
The Reward: We've tried to keep it great. Grand Prize is a round trip for two to East Africa. First Prize in each of the categories is $250. Ten Honorable Mentions will receive $100 each.

More Rewards: All winning entries will be published in a special, color-crammed issue of *Natural History* and will be exhibited at The American Museum of Natural History.

Some Hitches: The decision of the judges will be final. *Natural History* acquires the right to publish and exhibit the winning pictures. And *Natural History* assumes no responsibility for transparencies.

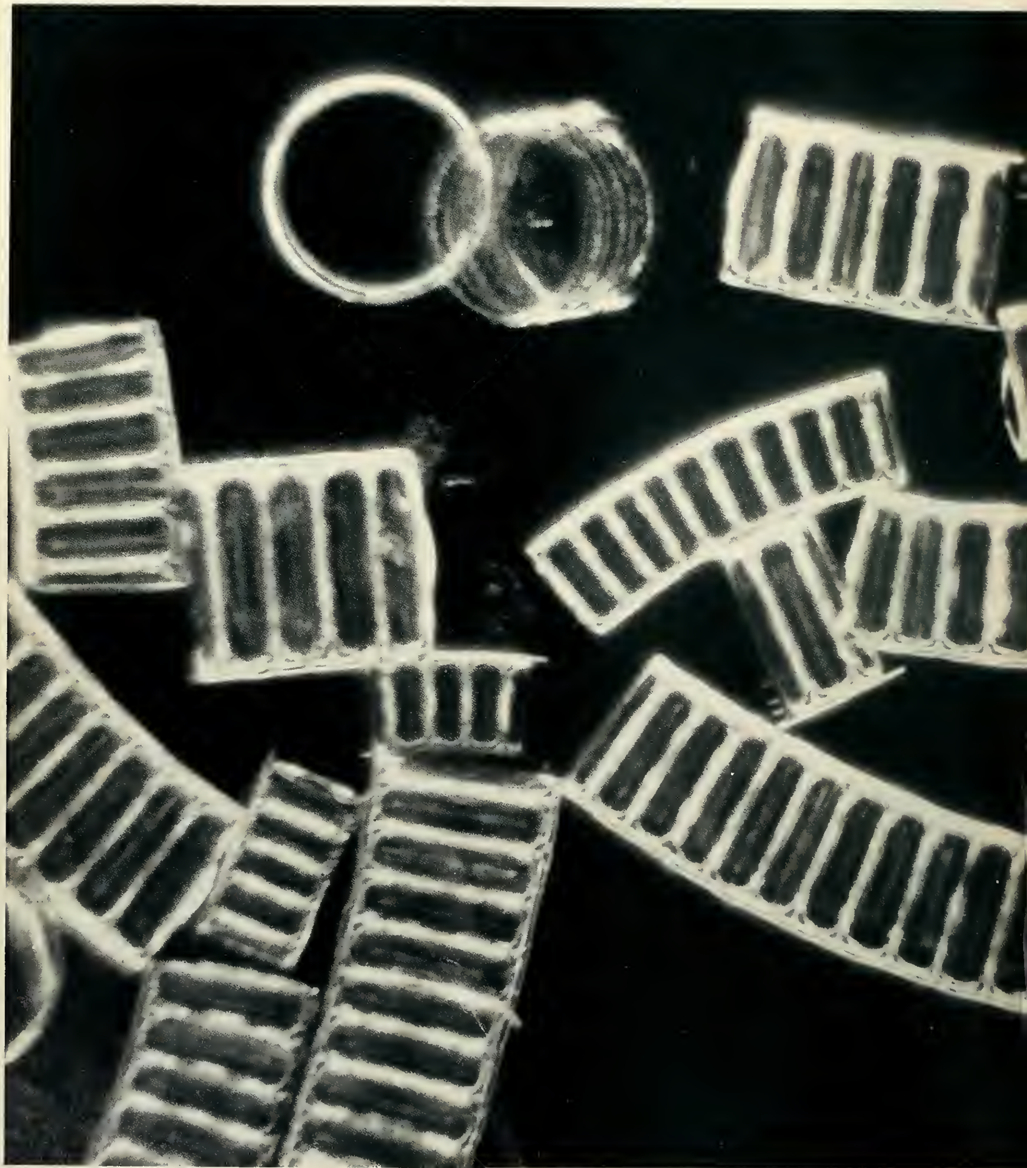
An important point: Pack your beautiful transparencies carefully and mail them to:

Photography Competition
Natural History Magazine
7 West 77th Street
New York, New York 10024



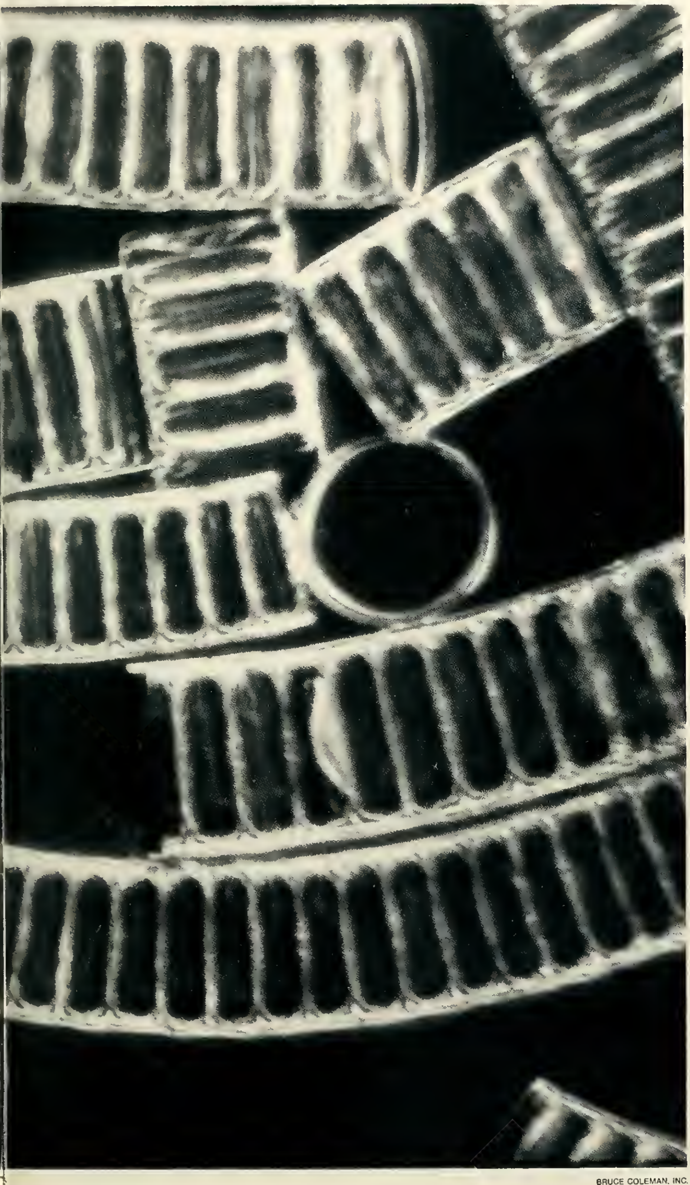
And a final thought. Good Luck.

Life-giving Oils in



Copyright ©1974 by Ritchie R. Ward. From the forthcoming book Into the Ocean World *by Ritchie R. Ward to be published by Alfred A. Knopf, Inc.*

the Strait of Georgia



BRUCE COLEMAN, INC.

Key substances in the diatom–copepod–salmon fry food chain of these northern waters are fat and wax

by Ritchie R. Ward

Every spring in the Strait of Georgia, between green-carpeted Vancouver Island and the snowy peaks of British Columbia, a fundamental drama of energy transfer unfolds among billions of living forms.

It begins with the May bloom of phytoplankton—mostly the one-celled plants called diatoms. These are the microscopic algae, which have elaborately fashioned shells of silica and chloroplasts, whose green chlorophyll is partly masked by a yellow brown pigment. "When first we see a sample of plankton, rich in diatoms, under the high power of a microscope," said Sir Alister Hardy, the British oceanographer and author, "it is like looking at a group of crystal caskets filled with jewels as the strands of sparkling protoplasm and groups of amber chloroplasts catch the light."

There are amazing differences in the forms of individual diatom cells and the ways in which they group themselves together. Some groups look like dozens of lollipops arranged in a circle; their flat disks

A class of one-celled algae, diatoms exist in many shapes. They frequently live in groups or are linked in ladderlike arrangements.

pointed inward and their handles pointed out like an elaborate necklace. There is one group of hourglass figures bent like a horseshoe. In another group, little pillboxes are threaded on a string or float as free individuals. Some have hairs or bristles or spines and some are S-shaped and bare.

Diatoms are also remarkable for the secondary products of their photosynthesis. Rather than storing the initial sugars and other carbohydrates, as most green plants do, diatoms produce fatty compounds containing fatty acids, which they manufacture from carbohydrates. Often the production is so great that the disintegrating diatoms leave an oily slick for miles across the water's surface.

It is nature's spring chemistry that leads to this tremendous diatom bloom. As the warming sun strikes the mountain peaks, the snowpacks begin to melt, and torrents of water from the heights rush down the Fraser River and its tributaries to the sea. And with this rush of water come nutrients washed from the soil: phosphates and nitrates and silicates, from which the diatoms build their shells. The Strait of Georgia abounds in mineral nutrients, and as the days grow longer, the diatoms multiply, doubling their numbers every day or two, until there are tons of them for every acre of open water.

Here the herbivorous animals of the sea find grazing of the richest sort. The most conspicuous, and the most plentiful, are the little shrimplike creatures known as copepods—so called because of their oar-shaped feet. The copepods are the first animals in this marine food chain: they are the predominant animals that graze on microscopic plants, and they in turn are the major food source for such smaller fishes as sardines, anchovies, herrings, and young salmon. They are also part of the diet of basking sharks and sei whales.

Copepods are by far the most numerous animals in the food chain of the sea. It is generally agreed that at least 80 percent of all ocean animals are copepods. There are more than 6,000 known species and possibly many more that have never been seen. Known species range in size from a pinhead to an inch or more in length, but those that are most important in the food economy of the sea are usually about the size of a grain of rice and belong to the genus *Calanus*. *Calanus helgolandicus* is the most important food of the herring, as Sir Alister Hardy showed in his studies of the North Atlantic herring fisheries. Other species, especially *C. finmarchicus* and *C. plumchrus*, have been the subjects of a recent and significant study of the marine food chain and the energy transformations that maintain it.

The Scripps Institution of Oceanography in La Jolla, California, is a principal center for this research. There, laboratory work under the supervision of Andrew A. Benson, a biochemist, is in full swing, and from there, at strategic times, the research vessel *Dolphin* puts out to sea. Owned by a San Diego businessman who lends her for investigative expeditions, the *Dolphin*—a trim, 95-foot vessel and one of the most sophisticated research ships afloat—is especially well outfitted for copepod work.

The *Dolphin*'s chief role is to provide a mobile laboratory for the study of copepods collected by its winch, cable, and plankton nets. Copepods in large numbers have been collected and frozen for later laboratory study. The *Dolphin* also serves as a floating station from which to observe the relationship between the diatom bloom and the appearance of copepods in great numbers.

In the spring of 1971, the *Dolphin* was busily at work in the Strait of Georgia. This mission, sponsored by the National Science Foundation and the Foundation for Ocean Research, was an essential phase of the continuing studies that are going forward at Scripps Institution on the metabolism of fats and waxes in the diatom–copepod–salmon fry food chain.

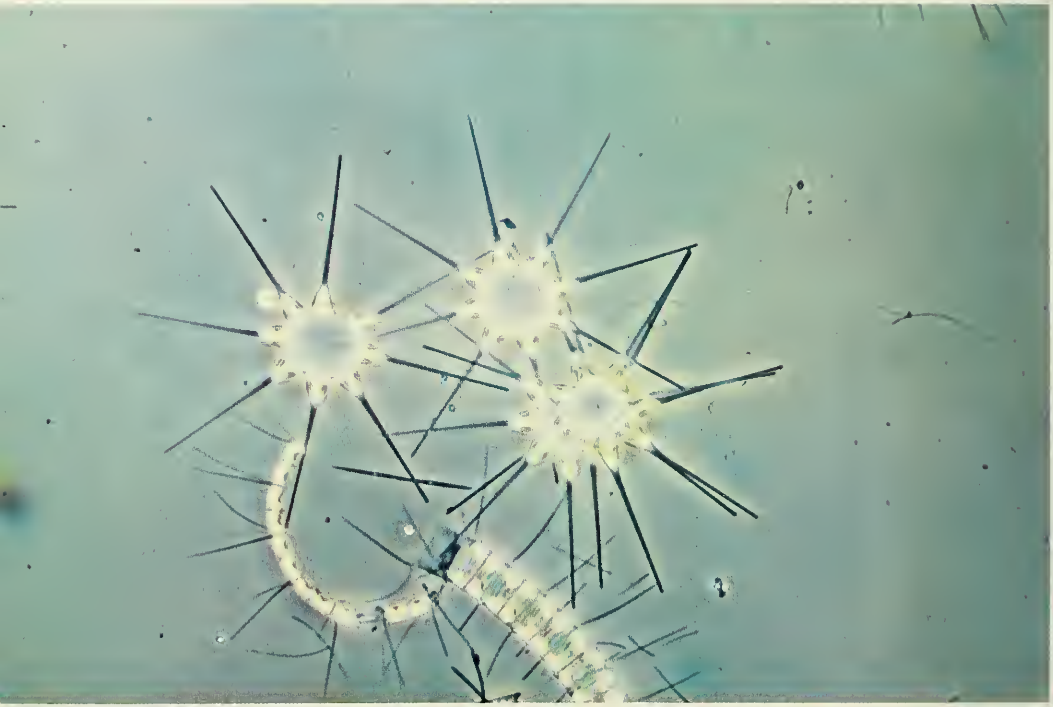
In May each year the copepod population ends its winter-long hibernation near the bottom of the cold, dark waters of British Columbia inlets, and the newly hatched animals rise to within thirty feet of the surface to graze on the spring bloom of diatoms. In May they have grown to maximum size, and that is accordingly the ideal time to collect them in great numbers to accumulate a supply of the waxes they contain. These are used in later studies on the nutrition of copepods in captivity, as well as of other marine animals.

Three basic facts justify the time, talent, and money expended on the study of mere copepods—animals that most people have never heard of, and fewer yet have ever seen. First, fats and waxes are essential to animal nutrition. Although these substances are similar in that both contain fatty acids, waxes, unlike fats, have no glycerine. Scripps scientists have estimated that off the coast of California alone the copepod population contains some 800,000 tons of liquid waxes. Second, a large fraction of all the photosynthetic products of the world's oceans is converted into liquid wax by copepods at one time or another, and we know that photosynthesis is the source of the world's life energy. Third, Scripps scientists believe that an understanding of how copepods, as well as fishes, handle fats and waxes in metabolism will lead to new understanding of critical factors in human metabolism—especially the role of cholesterols and the fatty aldehydes.

One of the first questions Scripps scientists working with Benson ask is why copepods behave as they do. The animals descend to the cold bottom waters in the autumn, and then when the spring diatom bloom occurs, the recently hatched young

Diatoms, which abound in both freshwater and seawater, are the first indispensable links in aquatic food chains. More than 5,000 species have been identified.

BRUCE COLEMAN, INC.



WILLIAM W. WIGHT

suddenly rise to the surface and feed voraciously on the one-celled algae. Do copepods receive some kind of signal that tells them it is time to rise and feed?

A fascinating clue comes from the laboratory, where copepods raised in captivity have been studied as they pursue diatoms that researchers put within their reach. Sustained observations reveal an odd kind of behavior. Individual animals are seen to dart in a straight line for a distance and then stop and swim round and round in a tight circle. They then dart in a quite different direction, stop and again swim around in a tight circle. This behavior is repeated over and over again, leading the researchers to conclude that this is the copepod's way of searching out, or "smelling," a mate or a mass of diatoms. The dart, it turns out, is made in a direction triggered by some biochemical signal, and the tight circling is a sensing procedure permitting the animal to detect delicate differences in smell intensity.

Because their skeletons sparkle in the light, diatoms are often compared to jewels. Their cell walls, composed largely of silicon dioxide, are thin and transparent and generally marked by a variety of small cavities.

The question of interest then becomes: what is the nature of the biochemical signal? Is it something akin to the human senses of smell and taste? The current view is that it is probably analogous to smell.

What, then, does a copepod smell? The odor, of course, arises from the prey—in this case, diatoms—so the search began for some chemical compound present in diatoms that copepods can detect in

ROMAN VISHNIAC

ROMAN VISHNIAC

seawater. Investigation has led to the present belief that copepods probably smell the polyunsaturated hydrocarbons that diatoms produce.

The next question is what does a copepod use for a nose? These animals have two pairs of antennae—often one is red; the other, colorless—that resemble the antennae of insects. Extending below the copepods' antennae are many fine hairs that, added to the main branches of the antennae, make up an arrangement something like that of a complicated television antenna. That scheme of structures, scientists at the Scripps Institution suggest, is what the copepod smells with.

Another question that arises concerns the behavior of the other participants in the copepod food chain. For just as the copepods become plentiful when the diatoms become plentiful, so four-inch baby salmon simultaneously come swimming down the streams where they were born and make the copepods their major diet. The clues as to what triggers this behavior in baby salmon are even more elusive than those explaining copepod behavior. But here, too, it is possible that a sense of smell may have some bearing. There is at least no question that salmon do have a sense of smell. After many years of research, investigators at the University of Wisconsin have shown that different streams in which salmon have hatched have different odors. Salmon respond to these odors and remember the ones to which they have been conditioned.

There may be some doubt about just how baby salmon sense that copepods are available; there is no question at all as to what results when the salmon eat them. About half the dry weight of a Vancouver copepod consists of stored liquid wax. This substance is thus the principal energy supply in the diet of baby salmon.

Through sensitive analytical methods, Scripps scientists have found that the salmon fry split the liquid waxes into fatty alcohols and

fatty acids. The salmon is a specialist in this process: most of its metabolism is engaged in the performance of this reaction most of the time. The same reaction also takes place in humans, but in the presence of many other simultaneous chemical processes. The salmon, therefore, is an ideal animal to use in studying how these liquid waxes are metabolized.

Somewhere in the conversion of the liquid waxes from the copepods into fatty acids there occurs—as an intermediate stage—the production of fatty aldehydes. So far, little of these substances has been found in any salmon materials that have been studied, but Scripps investigators are anxious to look for them in blood digestive tissues from young feeding salmon. Fatty aldehydes are of interest because they are conspicuous components of human heart muscle and brain tissue, making up 70 percent of some phospholipids in those tissues. But so far no one knows the complete story of what function they serve. Perhaps the answer will be found in salmon intestines and blood serum.

As research on the diatom–copepod–salmon fry food chain progresses, many other questions arise. For instance, when copepods eat diatoms of one species, do they produce a different kind of wax from the kind they produce when they eat another species? Copepods can survive long winters without eating anything. Obviously they do so by using stored waxes as a reserve supply of energy. This must mean that there is some way in which the rate of utilization of that energy reserve is regulated. Researchers believe that the rate is governed by enzymes, and they have good indications of which enzymes these are. But they want to know more about how the enzymes are regulated.

The tiny, shrimplike copepod, which feeds on diatoms, is the principal food supply for many larger animals. Liquid waxes contained in copepods are a source of energy for its predators.

F. LEE

One of the laboratory methods that Benson and his colleagues use in studying these questions is first to starve captive copepods and then feed them back to a normal state of nutrition. From time to time during this process the researchers take samples of a few animals for analysis. In Benson's words:

"We suspect that the waxes of the [copepod's] fuel reserve, since they are less readily metabolized than normal fats, serve the animal in periods of stress and starvation. The waxes allow him to survive at a limited energy expenditure for longer periods than possible with normal fat metabolic control mechanisms. We believe our work will provide an answer to this question, and from the answer we should derive and define a multitude of ecological relationships among predator and prey in the marine environment.

"As our understanding of the distribution, metabolism, and transport physiology of wax esters in fishes grows, we will be in a position to apply these relationships to novel ecological systems. For example, it is possible that grazing and predation rates may be estimated from wax levels in the predator and the prey. The path of energy reserves in the food chain may be followed by the very characteristic and specific 'fingerprint' of dietary fatty alcohol and fatty acid chain lengths and desaturation. With a key to the relationships between fatty acids and copepod fatty alcohols, we will have a way to determine 'who eats whom' in the ocean."

Raising copepods in captivity for laboratory research is a painstaking procedure. The fertilized egg hatches into a rather primitive, tiny larval stage called the nauplius, which is encased in a chitinous shell like that of a shrimp. The shell cannot expand, so as the larva grows, it sheds its outer covering from time to time, becoming a little larger with each molt. There are six of these larval, or nauplier, growth stages, which are followed by six copepodite stages during which the animal becomes more and more like the adult. When first hatched, the larva has three pairs of limbs that are used initially entirely for swimming. As development progresses, they evolve into the specialized oar-feet of the adult, into the antennae, and in the male of some species, into a kind of forceps for grasping the female.

The male copepod has an interesting way of performing the sex act. From a special gland, it produces a plasticlike substance, which it spins into a container that looks like a bottle with a very long neck. The male discharges its sperm into this "bottle" and then goes looking for a female. When she is found, the male fastens the neck of the bottle to an opening in one of her abdominal segments. The sperm then enter a storage cavity in the female, ready to fertilize the eggs as they descend from the ovary.

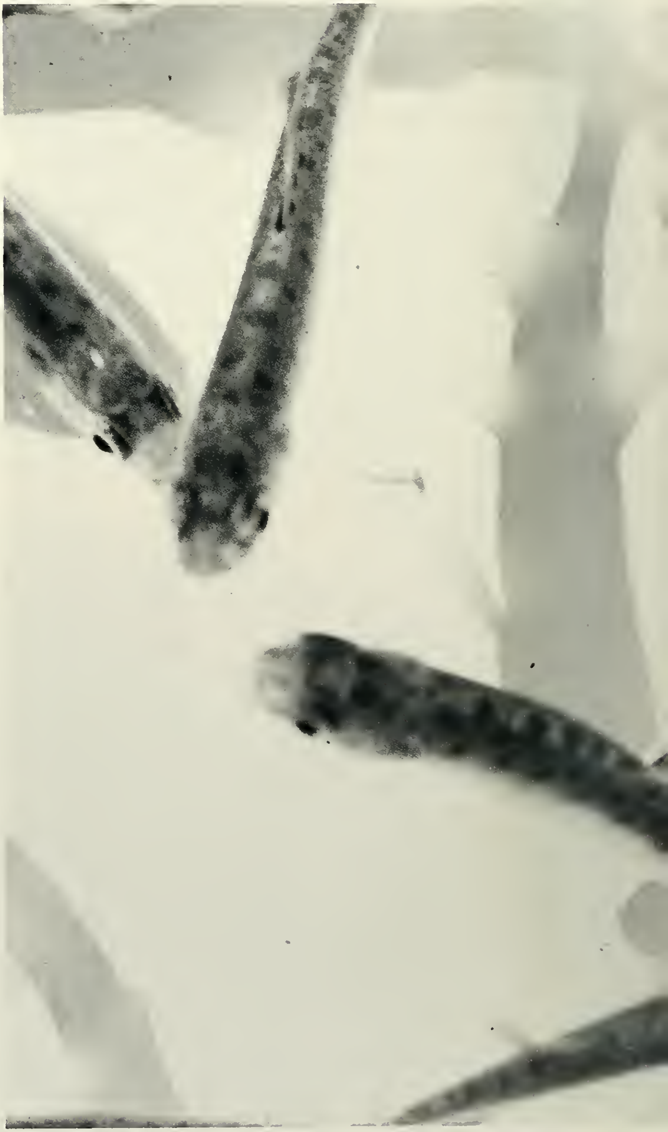
From the standpoint of the copepod's complex twelve-stage development alone, rearing them for experimental purposes is a delicate business. A further difficulty arises from the animal's dietary requirements. Copepods require a diet of live, fresh diatoms, so that a continuous support program of growing diatoms is also necessary. And, as in their home waters in the Strait of Georgia, diatoms must be supplied with seawater containing essential inorganic nutrients, together with the silica they need for building their shells. Finally, copepods do not thrive unless they are fed in small amounts at frequent intervals. Using this tedious method, investigators succeeded in rearing captive copepods throughout their complete life-cycles in the laboratory.

When the adult stage has at last been reached, the starvation and recovery experiments are ready to begin. To follow closely just what is happening in the metabolism of the copepod waxes, it is essential to take samples of animals at frequent intervals throughout the entire sequence of experiments; and because of the difficulties of rearing captive copepods, it is feasible to take only very small numbers of animals at any one time. This means that only such sensitive and delicate analytical procedures as chromatographic methods will serve.

In the copepod experiments, the Scripps scientists use thin-layer plates of silica gel; and in some cases, chromatographic columns of silicic acid. They also use radioactively labeled carbon 14 so that the developed chromatograms can be exposed to X-ray film to record the position of the separated compounds. By these means the researchers have been able to obtain accurate analysis of fats and waxes in samples consisting of no more than three individual copepods, each weighing no more than 1/140,000 of an ounce.

These experiments revealed that the triglyceride, or fat, that copepods contain serve the animals, in this case *Calanus helgolandicus*, as a short-term metabolic fuel. The liquid wax, on the other hand, is slowly consumed after the fat supply is depleted and is a long-term energy supply for several months. More broadly, it now seems clear that liquid waxes, such as those made by copepods, are a major medium for storing and transferring energy in a variety of marine animals throughout the food web of the deep ocean. Continued research along these lines holds out promise for increased understanding of many biological and ecological problems.

As an example, who would have guessed that a study of the metabolism of liquid waxes in copepods from the Strait of Georgia would have anything to do with the low water requirements of animals of the desert? Yet there seems to be a close relationship between them. The work of Knut Schmidt-Nielson, a physiologist at Duke University, on the water requirements of desert animals shows that they adapt to arid conditions by oxidizing fats, which results in the controlled production of water within their bodies. Similarly, whales and many fishes, whose diets are rich in fat, may be able to produce some of the fresh water they need through the metabolism of fats and waxes. It appears that the phenomena of fat and wax metabolism may be virtually as broad as the whole question of the accumulation, storage, and transfer



Salmon fry in the waters off the coast of British Columbia feed seasonally on copepods. How the baby fish know when copepods are plentiful is under study.

of energy throughout living systems.

The evidence mounts. We know that some plants produce fats from the carbohydrates made by photosynthesis; that copepods convert fats to liquid waxes; that salmon convert these waxes to fatty acids, which are highly nutritious to humans; that metabolism of fats or waxes produces more water than does the metabolism of other foods, and that some desert animals, and probably some marine animals, avail themselves of this opportunity; and finally, we know that some of the intermediate products that occur during these metabolic processes are found in human heart muscle and the human brain.

The whole subject of the production and metabolism of waxes, however, is in such a state of rapid flux and development that there can be no such thing as a summing-up. That will have to be left to some future historian of science. ☐

DON GURAVICH

The Programmed Extinction of the Sandhill Crane

If mismanagement continues, a bird that has survived nine million years could have only nineteen years to go

by Richard S. Miller

The sandhill crane is one of the oldest living species of bird. Bones from the Sand Creek formation in Sioux County, Nebraska, dating from the Lower Pliocene, are indistinguishable from those of modern specimens, suggesting that the species has survived virtually unchanged through nine million years of evolutionary history.

A large, graceful bird, the sandhill crane is about three and a half feet tall, weighs about ten pounds, and has a wingspread of six feet. Adults vary in color from uniformly pale gray to reddish brown, except for a red, unfeathered region extending from the base of the bill across the face to the crown of the head. This species has received far less attention than the whooping crane, its more spectacular relative, one of the largest and rarest birds in North America.

There is, however, reason for concern about the sandhill crane, which is also becoming increasingly rare in some areas. Unlike the whooping crane, which has been legally protected since 1916 and which is closely guarded from further exploitation, sandhill cranes are now hunted in parts of western Canada and the United States. This may be a serious mistake. Even though the hunted population may contain as many as 200,000 birds, this apparent abundance could be deceptive, for we do not have enough information about the species to manage it properly.

Sandhill and whooping cranes are shy, wary birds and will not nest in areas near human activity. Although once abundant and widely distributed over the North American continent, under pressure from human colonization and agricultural development they withdrew from the eastern seaboard in the early nineteenth century and retreated to the western prairies of the United States and Canada. There they were relatively secure until the late nineteenth and early twentieth century, when these lands, too, began to be developed for agriculture.

Because of the widespread alteration of their natural habitat, sandhill cranes began to decline throughout their range, and by the 1860s they had disappeared altogether from Ontario. The last recorded nesting dates in other parts of their former breeding range are: Illinois, 1890; Nebraska, 1904; South Dakota, 1910; and North Dakota, between 1915 and 1920. Today the breeding areas of the once widespread sandhill crane are so reduced that only four isolated races are left: the Cuban, Florida, greater, and lesser sandhill crane. All but the last are endangered.

The Cuban sandhill crane population, numbering about 100 birds, occupies a small area on the Isle of Pines. There have been no recent reports on its exact status, but it is listed by the International Union for the Conservation of Nature (IUCN) as endangered.

Even after northern populations of the species had disappeared from the eastern United States, the Florida sandhill crane was abundant in southern Louisiana, Alabama, southern Mississippi, southern Georgia, and south through Florida. But hunting and agricultural development have reduced this race to a few scattered populations in isolated areas of Georgia, Florida, and Mississippi. The Florida sandhill crane population, now estimated to be between 2,000 and 3,500, is also on the IUCN list and is protected from hunting.

The Cuban and Florida races of the sandhill crane are nonmigratory remnants of the population that once occupied the eastern seaboard. The greater sandhill crane, however, is migratory, nesting in scattered areas across the northern states, from southern Michigan to Oregon and Washington and north into British Columbia. Populations in the eastern part of its range winter in the same general area where Florida sandhill cranes reside. They are, therefore, relatively protected from hunting. But since western populations migrate with lesser sandhill cranes, which are hunted in several states and provinces, their status is less certain. There are about 6,000 greater sandhill cranes in North America, and although this race is not on the IUCN endangered list, it is listed by the U.S. Bureau of Sport Fisheries and Wildlife as an endangered continental subspecies.

The only nonendangered subspecies, the lesser sandhill crane, accounts for more than 90 percent of the sandhill crane population. Nesting in the arctic and subarctic,

Aided by their long legs and necks, sandhill cranes forage for small animals and plant matter in shallow water and wet meadows.

JEN AND DES BARTLETT—BRUCE COLEMAN, INC.

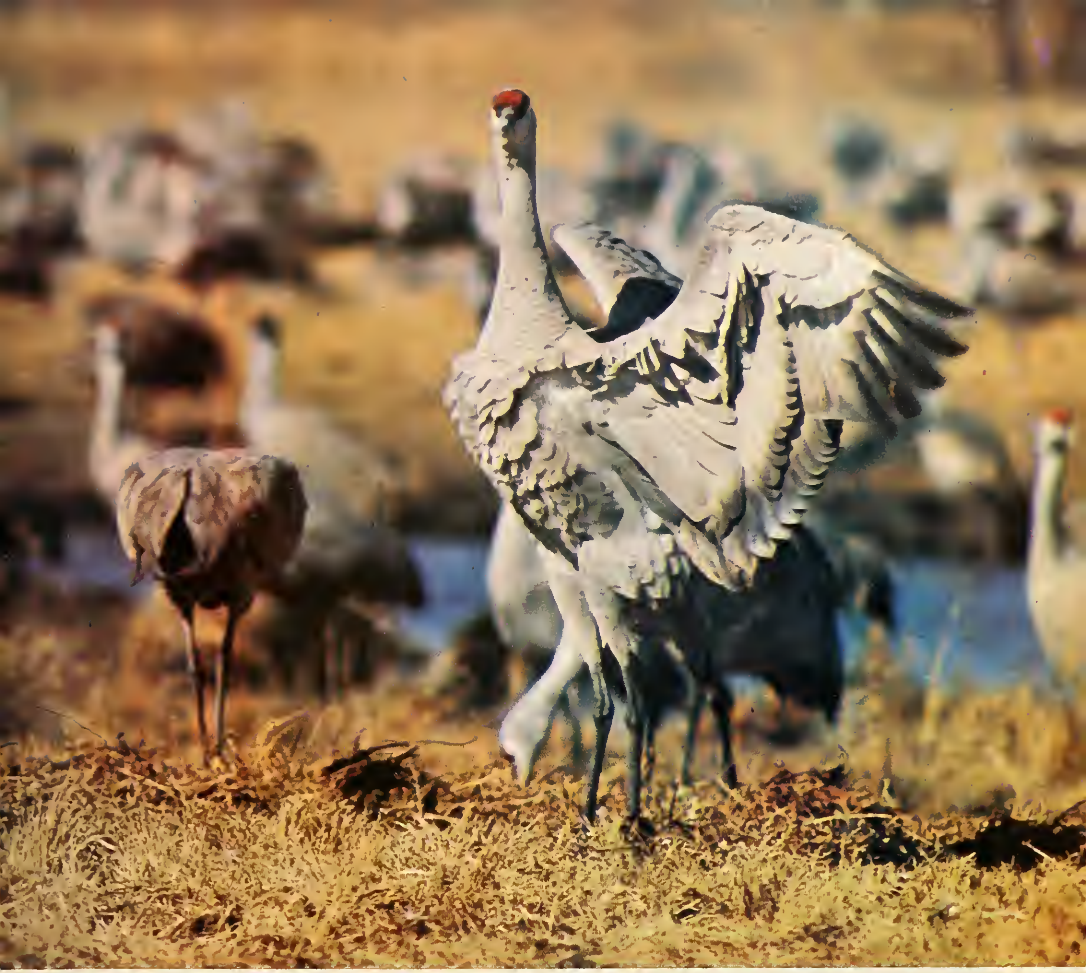
MARY M. TREMAINE

from eastern Canada west into Siberia, and wintering primarily in Texas, New Mexico, and Mexico, this subspecies has probably been successful because of its remote nesting areas. The best estimate of the lesser sandhill crane population is about 200,000 individuals.

When the Migratory Bird Treaty was signed by Great Britain and the United States in 1916, sandhill cranes became a protected species. But repeated reports of damage to cereal crops in North Dakota and, especially, in the province of Saskatchewan persuaded the Central Flyway Council to request hunting seasons, on the assumption that even a small reduction in the number of cranes would alleviate the damage they were causing. The request, however, was denied.

Crop depredations from sandhill cranes occur just before or during the fall harvest, when the migrating birds concentrate at "staging areas" in the agricultural regions of the western prairies. A major staging area is the Quill Lakes–Last Mountain Lake region of east-central Saskatchewan, which was a breeding ground for sandhill cranes before the development of the area for agriculture in the late 1800s. Concentrations of 30,000 to 35,000 cranes are common in this region in early September when harvest operations are in progress, and farmers in the area have been especially vigorous in their demands for crop protection.

During their feeding periods in the early morning and late afternoon, the cranes leave their roosts on shallow lakes and sloughs and fly out to grain fields, where they gather in flocks ranging from a few dozen to as many as several thousand birds. Crop damage is especially severe when the harvest has been delayed by adverse weather and the grain is allowed to lie in swaths to dry. In addition to scattering and trampling the grain while feeding, the cranes tear the swaths apart so that they cannot be picked up by combines.



Cranes tend to return repeatedly to the same field, and a few hundred birds can cause serious damage in several feeding periods. Because of especially heavy damage in a few areas in Saskatchewan, provincial authorities and the Canadian Wildlife Service in the fall of 1959 allowed farmers to shoot sandhill cranes.

In 1960 the Central Flyway Council, with support from the National Flyway Council, the Saskatchewan Department of Natural Resources, and the Canadian Wildlife Service, again recommended a hunting season. This time, the Secretary of the Interior authorized an experimental hunting season in eastern New Mexico, to be held from January 1 to January 30, 1961. This season was judged a "success"; hunters, who had previously shown no interest in shooting cranes, were persuaded by federal and state authorities to participate in the experiment, and a large number of cranes were killed.

Consequently, in the fall of 1961, thirty-day open seasons were authorized in Alaska, New Mexico, and Texas. Canada followed suit, and in 1964, limited seasons were established in Saskatchewan and Manitoba, mainly in areas where crop damage was most prevalent. When biologists of the Bureau of Sport Fisheries and Wildlife con-

As part of their dramatic courtship dances, cranes flap their wings, hop, and leap into the air. Both sexes engage in the displays, which start in winter and continue until the eggs are laid in spring.

cluded that the migratory population could withstand additional hunting pressure, open seasons were also authorized in Colorado in 1967 and in North Dakota, South Dakota, and Oklahoma in 1968.

The economic and political realities of wildlife depredation lie, not so much in the total amount of damage done or the over-all effect on the economy, but in the losses sustained by individuals. A Canadian Wildlife Service survey showed that an average of fifty-three farmers reported crop damage from sandhill cranes in the three-year period from 1961 to 1963, with an average annual loss of $184 per farmer. Some farmers, however, more seriously affected than others, were able to exert strong pressure on government officials to consider hunting as a partial solution to their problem, even though the only thorough study of crop damage by sandhill cranes has shown that hunting is not effective, and that there are other, more efficient ways to alleviate the problem.

Because sandhill cranes tend to concentrate in large numbers in migratory staging areas, eliminating the nuisance they cause would probably involve reducing the total population to insignificant numbers. Hunting in fields will force the cranes to move to other areas, but most crane hunting is "pass shooting" along fence lines or road allowances between the roosts and the fields where they feed. Moreover, if cranes are driven from one field, they will fly to another, which merely transfers the burden from one farmer to his neighbor.

One program, however, conducted for the past several years by the Canadian Wildlife Service and the government of Saskatchewan, has been highly effective. Much of the damage to crops in the Last Mountain Lake region of Saskatchewan has been on lands that are relatively unproductive for agriculture. Several of these marginal farms have been purchased and added to the Last Mountain Bird Sanctuary, forming a wildlife unit of 33,120 acres. Most of the land in the wildlife unit is native prairie, and the purchased farmland has been allowed to revert to prairie or has been planted with hay. In addition, eighteen fields, totaling 1,220 acres, have been seeded with barley to provide food for cranes and other waterfowl. The cranes prefer to feed as close to their roosts as possible, and the government-owned fields near the edge of the lake are usually their first choice. By the time they have consumed the grain in these fields, the commercial harvest is either completed or is usually far enough along so that the cranes can feed on the scattered grain remaining in harvested fields, rather than on unharvested crops.

The success of the Last Mountain

Unlike most birds, which sleep standing on their perches, cranes lie down and tuck their bills under their back feathers or wings.

JEN AND DES BARTLETT—BRUCE COLEMAN, INC.

Lake experiment suggests that there is no longer any justification for hunting sandhill cranes. But soon after open seasons were authorized there apparently was an unstated change in policy—from hunting to alleviate crop damage to hunting purely for sport, with an emphasis on "hunter days of recreation." In other words, when it became apparent that hunting was not a deterrent to crop depredation, the sandhill crane was removed from its status as a crop pest and placed in the category of a recreational resource.

The federal agencies should have known at the outset that unless the species was hunted to an unacceptably low population level, hunting could not alleviate crop damage, and it must have been equally clear that hunting seasons in Alaska, New Mexico, and Texas were unlikely to provide relief for farmers in Saskatchewan, where the problem originated. One likely explanation for their decision to authorize hunting—a policy that proved to be ecologically unsound and without merit—is that they could not resist the political pressures. Interestingly, these pressures came primarily from landowners, rather than from hunters, and the government agencies were in the unusual position of having to persuade hunters to shoot cranes in order to produce a "successful" season. The early settlers on the western prairies hunted both the whooping crane and the sandhill crane for food; like the other abundant populations of game species, cranes were important to the survival of these early pioneers. If cooked properly, the meat of a sandhill crane is excellent, but it is doubtful that today's crane hunters, with their modern tastes and social culture, shoot these birds for food or even know they are edible. From conversations with crane hunters, I have the impression that many cranes are discarded after they are shot, partly because of ignorance about their food qualities, partly because of a prejudice against eating a bird that looks so unlike our traditional game species.

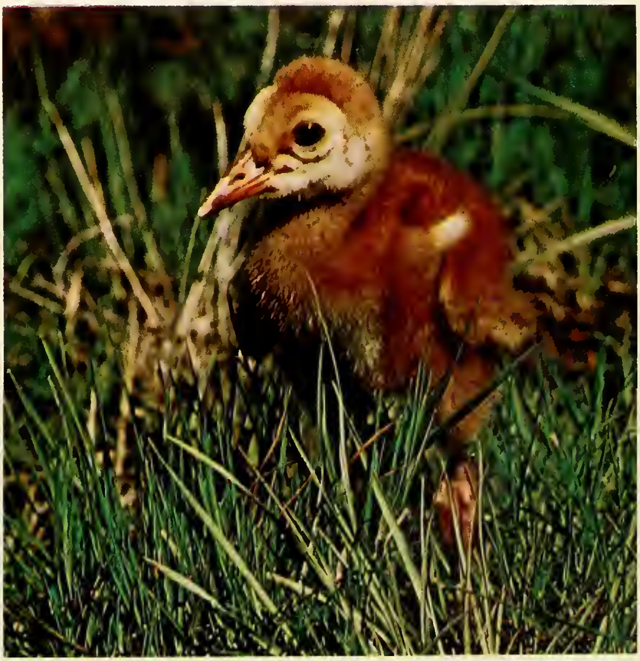
Unfortunately, the management agencies responsible for the welfare of the sandhill crane have conducted no surveys to discover why people hunt these birds, what they do with a crane after it is shot, or whether, in fact, there is a real interest in sandhill crane hunting on the part of a significant number of sportsmen.

With the change in policy to hunting sandhill cranes for recreation, the federal agencies responsible for the welfare of this species have created a new problem for themselves. As long as the sandhill crane is a recreational resource and not a crop pest, every state and province in the central flyway has a legitimate claim on its share of the resource, and the annual kill will become increasingly difficult to control. During eleven years of hunting the bird, there has been an increase in the bag limit and in the areas open to hunting, and now that hunters have accepted the sandhill crane as a game species, we can expect demands for even more liberal seasons. Aside from the ethical question of whether this unique bird should be hunted at all, we must also ask whether it is being properly managed and adequately protected.

According to the most recent estimates, the number of sandhill cranes killed annually in Canada and the United States is between 8,000 and 10,000 birds, with an additional crippling loss of about 25 percent. The total annual kill is, therefore, between 10,000 and 12,500, or about 5 to 6 percent of the total population of 200,000.

In an attempt to predict the consequences of different management alternatives on the welfare of this species and to develop appropriate management strategies, scientists at the Yale University School of Forestry and Environmental Studies

Although able to walk as soon as it is hatched, a young crane develops slowly, staying with its parents until the following spring.



JOSEPH VAN WORMER—BRUCE COLEMAN, INC.

Klamath National Refuge in California, right, provides protection for sandhill cranes, which are hunted in some areas of the west.

have been experimenting with computer simulation models. If, for example, we can provide a computer model with accurate data for the various factors affecting the natural gains and losses of a protected population, we can then examine the effects of different hunting pressures on long-term population trends. Or we can determine the amount of hunting a species can withstand while still maintaining a desirable population level. A simulation model is also useful for identifying weaknesses in the data needed to manage a species. We often find, for example, that some parameters, such as juvenile vulnerability to hunting, have relatively little effect upon population trends, while age at first breeding is extremely important.

An immediate problem in attempting to develop a model of a sandhill crane population is the lack of accurate information on such critical parameters as length of life, the age at which adults first breed, the proportion of breeding adults in a population, causes and rates of natural mortality, and the number of young added to the population each year. We know that a sandhill crane is a long-lived bird and can assume that its life-span is from twenty to twenty-five years. Like other large, long-lived birds, sandhill cranes do not breed in their first year as adults; in fact, they probably defer breeding for four or five years. The normal clutch is two eggs, but a pair of cranes seldom raise more than one young to maturity each year.

While we do not know the exact reason, their low productivity is probably related to the difficulty of finding enough food to raise more than one young at a time. Also young cranes require a good deal of experience in the company of their parents before they are accomplished flyers and foragers; they remain in family groups with their parents through the fall and, in some cases, into spring before they are fully independent.

ROBERT J. NORTHSHIELD

One of the critical problems in wildlife management is to determine the number of young added to the population each year, or annual recruitment. In studying cranes, wildlife managers, using as an index the ratio of juveniles to adults in samples killed by hunters, have arrived at an annual recruitment rate of about 18 percent. Recent studies, however, have shown that young cranes are far more likely to be shot than adults.

Since game bag checks are not an accurate indicator of annual recruitment, we have undertaken surveys of sandhill cranes feeding in fields or flying between their roosting and feeding areas at Last Mountain Lake. These show that the proportion of juveniles in the fall population ranges from about 4 to 8 percent; thus, the reported mortality from hunting, 5 to 6 percent, is nearly equal to or, at times, exceeds the annual recruitment of new individuals into the population, leaving no room for natural mortality.

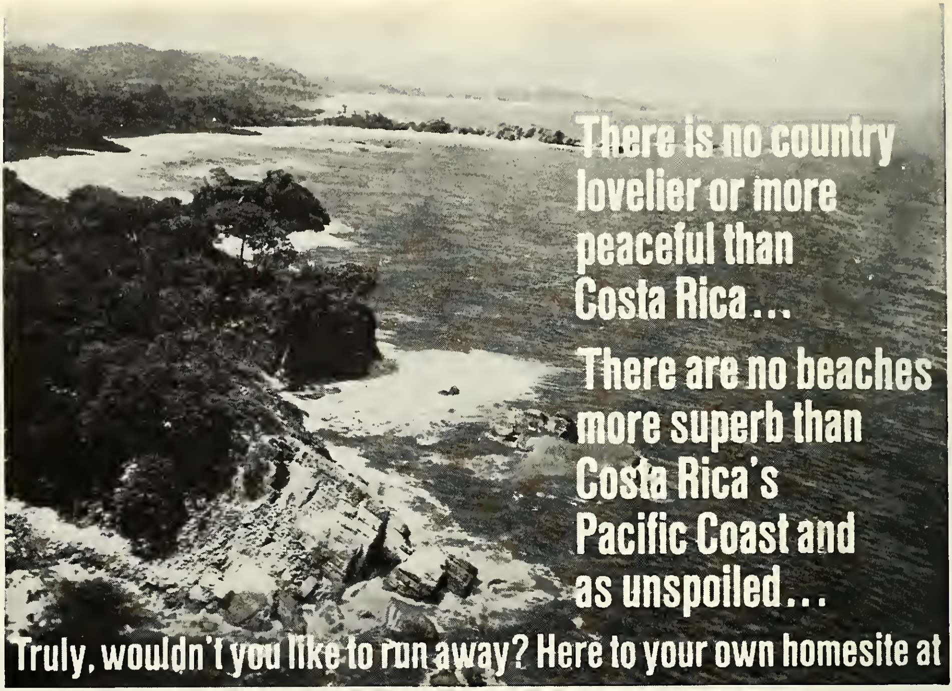
When the computer model is used to simulate the results of different levels of hunting pressure, we find that at currently reported rates of hunting, the population would become extinct in nineteen

years. If the total annual kill were reduced to 8,000 per year, the population would be extinct in thirty-eight years. If the annual kill were only 4,000, the model tells us that the population would decline from its present level of about 200,000 cranes to about 126,000 and, at this amount of hunting pressure, would stabilize at this value.

The methods now being used to estimate population size are so crude, however, and the results are so variable, that it is doubtful that a significant decrease would be detected in time to take remedial action. When population estimates showed a 35 percent decrease between 1964 and 1966, wildlife managers apparently assumed that this was a sampling error, rather than a real decrease in numbers, and hunting regulations were liberalized, not restricted.

Unfortunately, the federal and state agencies responsible for sandhill cranes have relied on traditional management methods. These might be appropriate for such species as mallard ducks and pheasants, which have high reproductive potentials, but they should not be applied to such animals as sandhill cranes, which have low reproductive capacities and recover slowly from reductions in population size. If, for example, sandhill cranes were hunted at the current rate for ten years and then totally protected from hunting, the population would be only nine years away from extinction and would require about eighty years to return to its present level.

Solutions to the problem of endangered or potentially endangered species do not necessarily require the removal of humans from the animals' environment—in most cases this would be impossible. But we do need to find ways to live in better harmony with wildlife. Perhaps in the case of the sandhill crane, as well as other endangered species, we can use a human invention, the computer, to find the weaknesses in our traditional approaches to wildlife management. Then we can adopt practices that will guarantee the survival of what is left of our natural legacy. ☐



There is no country lovelier or more peaceful than Costa Rica...

There are no beaches more superb than Costa Rica's Pacific Coast and as unspoiled...

Truly, wouldn't you like to run away? Here to your own homesite at

BEACHES of NOSARA

Truly, wouldn't you like to run away here to this garden of ours? Doesn't your bruised spirit need the soft touch of loving people, your tense body the pure spray of clean, *clean* air filtered by sunshine? Don't you long for a place where every day is gentle summer, where tree-wrapped mountains in the background stretch 12,500 feet to the sky, where tumbling streams and waterfalls and wave-lapped beaches beg to heal you?

In all truth, isn't it a sort of self-destruction to accept without demur (as maybe you do) the dank cheerless clutch of winter cold—further aggravated by a fuel shortage?

So we ask you again: wouldn't *you* like to run away here to a place of your own in this nature-blessed country, inhabited by a people who deserve every bit of the beauty they've been given?

For the astonishing fact is that the Costa Rican people—perhaps like none other on earth—live in peace. All of them, each with the other, live and work in *PEACE!*

Consider them, the 1¾ million of them: handsome, gentle, literate, industrious and (phenomenon of our times!) kindly—a European-sprung people who are constantly embracing, shaking hands, even with strangers, a people to whom law and order is symbolized by a smiling policeman armed with nothing more menacing than a whistle, directing traffic with a murmured *"por favor."* The phrase "law and order" doesn't have an ominous meaning here. It's incredible for a foreigner to learn that there is no army in Costa Rica (without an army, Costa Ricans say, there is no danger of a military take-over). The only military uniforms worn are by police and there are more schools in Costa Rica than there are uniforms. Not alone more *school-children* or more *school-teachers* but actually more *schools* than military uniforms! Amazing? No wonder that Gov. Nelson Rockefeller, having undergone a rather stormy Latin American tour in 1968, exclaimed happily when he finally got to *simpatico* Costa Rica: "This perfect jewel of a country!" *The NEW YORK TIMES* in an editorial on February 5th, 1970 headed *"Costa Rica's Example"* praises the solid democracy of this tiny country and says in part: *"Doing what comes naturally, a half-million voters have brought off (Costa Rica's fifth successive) peaceful presidential election in twenty years."*' Yet, it isn't only each other whom Costa Ricans like. There is no xenophobia here at all: foreigners are warmly welcomed and North Americans, especially, are cherished. Nearly 15,000 of us from the U.S. live and prosper in Costa Rica. English is widely spoken, and the word has been gradually slipping out that in this *"jewel of a country"* lies the fulfillment of the wistful dream of so many harassed Americans: the mind picture of that perfect retreat where climate and man are in gentle harmony with each other.

It's rather astonishing that this spectacularly beautiful country, really not that distant from the States, is much less familiar to Americans than the islands of the Caribbean. Almost everyone knows, and many have visited, the grouping of tropical Edens called the West Indies—their fabled greenness, the sparkling waters in which they are set. Yet Costa Rica's climate has all the balm of its island neighbors and is more exhilaratingly varied. The sea that stretches along the east coast of this slender strip of Central America *is* the Caribbean. Go west less than 150 miles and there is the Pacific: nowhere does this greatest of oceans wash more beautiful shores than Costa Rica's. Incongruously, some travel writers have called this country "The Switzerland of Central America"; still it is true that Costa Rica's mountains are as glorious in their tropical setting as the Alps in *their* ambience. And it is further a fact that these mountains aid in making the climate the delight it is. San Jose, the capital, is in the central plateau, 3500 feet above sea level, and about midway between the Caribbean and the Pacific. The city's climate is simply nothing less than perpetual Spring with the mean temperature steady at 70° every month of the year. But even at Pacific coast, sea level—at our BEACHES OF NOSARA, for example—even here, the mean annual temperature is only 78 degrees accompanied by humidity so low that it can't be matched by the Caribbean islands. And not to put down the exotic West Indies, there's a good deal more of Costa Rica that the islands can't match. Nature thrives on an immense scale here. Naturalists have identified 762 species of birds (in *all* of the United States, 130 times Costa Rica's size, there are 725 varieties). And such birds! Partridge, parrots, cuckoos, toucans along with the wrens, thrushes, orioles, finches. We have deer, raccoon, monkeys. Costa Rica's soil is so fertile that Texas cattle ranchers are incredulous that what would be prized crop acreage in their state is used casually as cattle-raising land here. And what lush growth springs from the soil! Great forests of majestic trees; lignum vitae can be so huge that a single tree's branches may shelter an entire herd of cattle. There are groves whose boughs bend under the weight of fruit—citrus, mangoes, bananas, coconuts. Costa Rican coffee is unparalleled. Hundreds of varieties of orchids grow wild. We produce vegetables of a size and flavor such as few North American housewives have seen.

Costa Rica has a record of steady economic progress and every foreigner who has come here is instantly aware that this progress is mounting toward affluence. Clearly, a country of such natural richness and with so extraordinary a people, puts fresh meaning into the overworked word *opportunity*. Oh, opportunity is here, all right. And for none better than for North Americans. There are no restrictions against private investment and the list of American businesses, small and large, is long. For you who simply want to retire, there are special privileges if you are not a Costa Rican. All you have to prove is a guaranteed income of $325 monthly for you and your wife and you are exempt from paying taxes.San Jose 100 airmiles away has everything—for soul as well as the stomach. Opera, symphony, splendid movie houses, theater (its National Theater, marbled and mirrored, is a graceful replica of L'Opera in Paris). Many doctors and surgeons are from U.S. medical schools; the hospitals are excellent. You can buy anything in the handsome shops and the cost of living is joyfully low. T-bone steak, eggs, vegetables, fruits are far below U.S. prices.

Education is a positive obsession in Costa Rica. There are 2,379 elementary schools with 350,000 children attending, and 112 high school, art academies, business schools, etc. The beautiful complex of the University of Costa Rica has an enrollment of 12,000 students. And the academic standing of the English language private schools is very high. The most prestigious of these accommodates North American children at a tuition of $38 a month. And that includes busing to and from school!

San Jose has a fine airport, one of the largest, most convenient and modern in Central America, and the jet flight from Miami via LACSA is 1,123 airmiles and by schedule takes about 2½ hours and presently costs $200 round trip. For the autoist the drive from the States along the Pan American Highway is a memorable one; south of Cartago in Costa Rica, the famous road climbs to its highest elevation—10,931 feet.

So it had to happen: Here we were, a group of Americans—land developers. We'd heard of Costa Rica and we came here, instantly to be entranced by its beauty and won by its people. We knew quite soon—almost like the original Spanish discoverers who gave it the name *"rich coast"*—that this was the country we'd been looking for. All that remained now was to find the quintessential tract of land that had everything—natural loveliness, serenity, climate, beaches. We found it. We found it in the peninsula of Nicoya directly on the Pacific. And we named this tranquil place . . . BEACHES OF NOSARA . . .

We've employed many superlatives in this ad—maybe, you'll suspect, even extravagances. Yet at the risk of once more stretching your bounds of credibility, we say this: that nowhere in the world will you find more glorious beaches than the two miles of beautiful white sand and unimaginably clean, clear sea that front our property. There is one section that is modestly compared to the best surfing Hawaii has to offer; and, wonderfully for the less adventurous, there is a long piece where the sea is quiet and where even infants can play in the water as it rolls gently onto the sand. If you're a shell collector you'll find, day after day, specimens you've never before seen. And out from shore are the boating and the skin diving, the fishing. A world of fish, a treasure-house for you, if that's your passion: tuna, dolphin, wahoo, grouper, snapper—the whole catalog, believe it. How rare to discover that today—a pure sea teeming with healthy fish. Yes, as much as anything it was the ocean and the beaches that caused us to choose NOSARA.

But then one turns his back on the Pacific and looks out at the land and isn't that something to see—this rich-soiled, lushly-covered sculpture of hills and valleys! It is big—3300 acres—but we intend to convert only a *part* of it to homesites. We've brought in ecologists and other scientists to help us preserve the natural beauty of this place. We have laid about 35 miles of horseriding trails, all within the boundaries of our property. If a precious tree stands in the way of a bulldozer the tree stays; we bend the road around it. If it's to be a match-up between "progress" and nature we'll ride with the trees and the birds.

But of course we've brought in the machines and used them. Every site in BEACHES OF NOSARA fronts a road. Every homesite is guaranteed electricity and pure water. Two tennis courts are ready for play. We expect our superb golf course with 9 holes to be completed in 1974. We've built a charming motel with club facilities and an airfield to bring you here quickly from San Jose.

We're not new to this profession. We've been developers in the West Indies and we do appreciate those magical islands. But this is the simple truth: no island in the Caribbean can claim what we have in this ad. And when one realizes that some improved sites in the West Indies have now soared to fantastic prices—$12,000 and up for a quarter-acre is now becoming the rule, then BEACHES OF NOSARA becomes almost too good to be true. For the price of our homesites range from $4,500 for a quarter-acre to $24,000 for two acres, 4% down and 2% a month, with no interest charges! And that *includes* roads, electricity, water, one year free golf membership and the unlimited use of the natural paradise that we've inherited and are preserving for you. An even greater bargain are the ranch sites in the PALMS OF NOSARA, priced as low as $5,200 to $11,000. These are less than 6 cents per square foot for ranch sites from 2 acres to 6 acres. The ranch sites have magnificent views of the Valley of Nosara and the surrounding mountains, plus use of all the recreational facilities at the BEACHES OF NOSARA. Ranch site owners in the PALMS OF NOSARA section have the option, at their own expense, of installing individual wells and generating plants or of building connections to the community water and electrical system located in BEACHES OF NOSARA.

We're running out of space and there's so much more to tell you. Some of you may visit us after reading this message. Most cannot. For those we have prepared a thick portfolio. It includes a large color brochure, maps, house plans, and a 96-page condensation of Prof. Donald Lundberg's authoritative book *"COSTA RICA."* All this is FREE.

Our portfolio also tells you how to go about reserving a homesite in BEACHES OF NOSARA and spells out our money-back guarantees: an unconditional 60-day deposit refund warranty; and a full year after signing contract to visit the property and see for yourself whether it delights you. If not, every penny you'd have paid in is refunded without a word.

We're quite certain that we have something very special in BEACHES OF NOSARA and we already know that the response to our advertising is going to be quite lively. We sincerely urge you—if you wish to be in time for the choice lots—to fill out and mail the coupon right away. Our portfolio is free and you are under no obligation at all. Indeed, no one will ever phone you or call on you. It's only the mailman you'll see.

BEACHES OF NOSARA Dept. M-8B
1201 Broadway, New York, N.Y. 10001

Please send me without obligation your complete portfolio including color brochure, maps, and Prof. Lundberg's book *"COSTA RICA."*

Name . . . .

Street . . . .

City . . . . State . . . . Zip . . . .

Obtain HUD property report from developer and read it before signing anything. HUD neither approves the merits of the offering nor the value of the property as an investment, if any.

"A verified statement & offering statement has been filed with the Dept. of State of the State of N.Y. The filing does not constitute approval of the sale or lease or offer for sale or lease by the Dept. of State of any officer thereof or that the Dept. of State has in any way passed upon the merits of such offering. A copy of the offering statement is available, upon request, from the subdivider." NYA 73-1556

The Blind Staggers

Some rangeland plants have the peculiar ability to absorb large amounts of selenium from the soil. Livestock that graze on those plants sicken and die

In the summers of 1907 and 1908 about fifteen thousand sheep died suddenly and unexpectedly in a specific area north of Medicine Bow, Wyoming. The Wyoming State Board of Sheep Commissioners attributed the deaths to acute poisoning by toxic plants, generally considered to be members of the vetch group (genus *Astragalus*) and the woody aster group (genus *Xylorrhiza*). Within the next several decades similar occurrences were reported throughout a region that included Colorado, Wyoming, Utah, South Dakota, Nebraska, Kansas, and parts of Montana. In each case, the stricken animals, usually sheep but sometimes cattle and occasionally horses, developed symptoms of either alkali disease or "the blind staggers" after grazing heavily in certain areas.

Of the two diseases, the blind staggers is far the more severe. Animals that have eaten *Astragalus* or *Xylorrhiza* start to wander in circles, stumbling over any obstacles in their way. Their appetites and thirst diminish; then their posture alters, their front legs weaken, and their vision becomes impaired. Still later, symptoms of paralysis appear, tongue movements and swallowing reflexes are blocked, severe abdominal pains follow, and ultimately, respiratory failure leads to death.

The less dramatic symptoms of alkali disease are loss of hair, especially from the tail, and the cracking and partial sloughing off of the hooves. Hoof material regenerates periodically, but the cracking causes such extreme tenderness that animals suffering from the disease are unable to graze well. It has proved impossible to raise to marketable size livestock affected with alkali disease, and many ranchers have gone bankrupt in the attempt.

As livestock losses from these two diseases increased over the decades with no known means of prevention, the ranching industry turned to science to unravel the mystery. If the suspected plants did indeed contain a material sufficiently poisonous to cause alkali disease and the blind staggers, why did their toxic action occur only in certain restricted areas? The solution turned out to be as bizarre as any in toxicology, for the chief clue was selenium, an element almost as rare as gold. Discovered in 1817 by the great Swedish chemist Jöns Jacob Berzelius, selenium is generally found in soil at a concentration of only about 2 parts per million, although in rare cases the concentration has been known to go as high as 100 parts per million.

Selenium is thought to be of igneous, or volcanic, origin; it occurs usually in the form of salts such as iron selenide in Cretaceous rocks, outcroppings of which are scattered throughout the rangelands of the western United States. The relevant point for the saga of the blind staggers, however, is that both *Astragalus* and *Xylorrhiza* possess a prodigious ability to absorb from soil large quantities of compounds containing selenium. *Astragalus bisulcatus,* the most poisonous of the vetches, is able to accumulate up to 5,530 parts per million of selenium from soils with concentrations of only about 2 to 100 parts per million. *Xylorrhiza* and other toxic species accumulate selenium somewhat less powerfully, but all plants that cause the blind staggers have this same remarkable property.

When *Astragalus bisulcatus* plants are grown in a nutrient solution in which the amounts of the various mineral elements are carefully regulated, the selenium content produces some unexpected effects. So far as is known, selenium is not absolutely essential to the growth of any plant, but it clearly enhances the growth of *Astragalus bisulcatus* and related plants. The dry weight and height of an *Astragalus* fed modest amounts of selenium may be five to ten times greater than one totally deprived of the element. This probably accounts for the unusual adaptation of *Astragalus* plants to an ecological niche that is rich in seleniferous rocks. These plants act as wicks, drawing in the element from the surrounding rock and causing a high concentration to accumulate in the area around their roots. The selenium content of the soil around such plants could theoretically become high enough to cause direct injury to nearby plants of other types. This has not been definitely proved in nature, but laboratory experiments have shown that plants unable to accumulate selenium may be dwarfed and show leaf bleaching when subjected to the same levels of applied sodium selenite, a usual source of the element that stimulates growth in *Astragalus.* The roots of the inhibited plants frequently thicken and develop suppressed lateral roots of a pinkish color due to intracellular deposits of elemental selenium.

Why does the selenium absorbed by a plant cause extreme toxicity upon its ingestion by an animal? First, it should be noted that, unit for unit, selenium in an *Astragalus* plant is much more poisonous for an animal than is the inorganic salt, sodium selenite. This means that the plant must transform accumulated sodium selenite into some other, more toxic form. Furthermore, it has been shown that all plants collect selenium far more efficiently if it is fed to them as an extract of *Astragalus*, rather than as a selenite salt. Chemical fractionation in the laboratory of the water-soluble selenium-containing extract of *Astragalus* revealed an unexpected aspect of the plant's metabolism.

It is well known that selenium is a chemical analog of sulfur. This element, essential to all living cells, has a variety of functions in the organism, the most important of which is its presence in almost all proteins. Proteins are composed of some twenty different amino acids linked in a specific order, and two of the twenty, cysteine (or cystine, its oxidized form) and methionine, contain sulfur. It appears that selenium imitates sulfur so closely that the *Astragalus* plant has come to substitute it for sulfur in its protein chain by making analogs of the two sulfur-containing amino acids, which are called seleno-cysteine and seleno-methionine. And when ingested by animals, these compounds produce disastrous symptoms of toxicity. Their toxicity is probably related to their competition with the normal sulfur-containing amino acids for incorporation into proteins. Thus, animals that receive amino acids containing selenium in effect suffer from an insufficiency of the amino acids that contain the essential sulfur.

When, after grazing mainly on grass that contains about ten to thirty parts per million of selenium, animals develop symptoms of alkali disease, they may be cured by changing to a diet lacking selenium. Supplemental feeding of proteins rich in sulfur-containing amino acids also can prevent the development and help alleviate the toxicity symptoms of the selenium-containing diet. But when animals

Jack Daniel's OLD No 7
RDWARE
NITURE
BAND

If you can't find this record, Harold Pool has it for $5.98 plus 35¢ postage at the Lynchburg Drug Store, Lynchburg, Tennessee 37352.

JACK DANIEL'S SILVER CORNET BAND reached its peak in 1894. Thanks to Paramount Records, you can still hear their music today.

Jack Daniel started the group to sell whiskey at saloon openings and political rallies. Today, we've dusted off some of their old-time sheet music and carefully recreated a sound that hasn't been heard for 75 years. (Finding these old-style mellow conical horns took us from an antique dealer's attic in Nevada clear to Paris, France.) The result is a Paramount Records' album that's available wherever good records are sold. If the music inspires a sip of Jack Daniel's, don't be surprised. That's *just* what Mr. Jack intended it to do.

CHARCOAL MELLOWED
DROP
BY DROP

Tennessee Whiskey • 90 Proof • Distilled and Bottled by Jack Daniel Distillery
Lem Motlow, Prop., Inc., Lynchburg (Pop. 361), Tennessee
The only Distillery placed in the National Register of Historic Places by the United States Government.

ingest *Astragalus* with more than 5,000 parts per million of selenium, nothing can be done; they are doomed to develop the blind staggers disease and die.

There are also other interesting aspects to the problem of selenium toxicity in the field. Plants containing selenium, like their sulfur-containing analogs, frequently have an offensive garlicky odor. Horses are choosy eaters and tend to avoid such plants; thus they are rarely afflicted with the disease unless other plants are unavailable. Cattle are much less selective and tend to graze indiscriminately, thus occasionally consuming large quantities of *Astragalus* and especially *Xylorrhiza*, which grows abundantly on the desert floor. Sheep actually seem to prefer *Astragalus* and *Xylorrhiza* to other foods and seek them out. This difference in nutritional habits accounts for sheep being the most common victims of the blind staggers.

About half a pound of *Astragalus bisulcatus* will kill a sheep thirty minutes after ingestion; smaller quantities take a longer time to produce their effects. About 400 to 800 parts per million of selenium are fatal when ingested at the rate of about 8 to 16 grams per kilogram of body weight (about ¼ ounce per pound of body weight). After an animal ingests *Astragalus* material, selenium is found in all organs, but it appears to be most abundant in the liver, blood, kidneys, spleen, and brain. It is eliminated from the body mainly by means of the urine; some is also lost in the feces, in the sweat, and in the breath.

A curious sidelight to this story rests in the properties of another species of *Astragalus*, called locoweed. This plant, too, causes similar symptoms and poisoning by virtue of an organic molecule, but it does not contain high quantities of selenium, and so far as is known the effective mechanism is not related in any way to selenium metabolism.

What can be done to combat these devastating diseases, produced not by a grazing plant itself, but by the plant's absorption of an element that in itself would not normally be toxic? The obvious tactic would be to prevent grazing in the regions where *Astragalus*, *Xylorrhiza*, or other seleniferous plants thrive. But this would rule out vast areas of the western range at a time when the supply of food is becoming more and more critical. Another possible tactic would be to treat the area with herbicidal chemicals that would kill the offending plants. But since these plants tend to dominate seleniferous areas because their growth is promoted by selenium, tremendous quantities of herbicides would be required. Such an operation would therefore seem economically unfeasible and also ecologically unattractive, as no herbicide is without some undesirable side effects. A third possibility would be to swamp the area with sulfur-containing materials, which the plants would absorb. The ability of *Astragalus* or other seleniferous plants to convert inorganic selenium to seleno-amino acids depends on the ratio of sulfur to selenium. Even when this ratio is about three to one, optimal incorporation of selenium into the toxic amino acids occurs, but if the proportion of sulfur were raised, the formation of the seleno-amino acids would tend to decline. Although heavy sulfate fertilization is theoretically a possible way of mitigating the trouble, it is unlikely to become a practical, effective weapon against selenium poisoning. At the moment, however, while there seems to be no permanent resolution to the problem, the blind staggers is not a serious menace because ranchers have learned to avoid seleniferous areas for grazing.

What danger does this disease pose to humans? Practically none, it would seem. Presumably if humans were to ingest amino acids containing selenium, they, too, would develop symptoms equivalent to alkali disease or the blind staggers. But, in fact, the afflicted animals show such terrible symptoms that they are always identified and never used for meat. Consumption of grains grown in the seleniferous regions is also avoided. Nonetheless, since selenium can be found everywhere in small quantities, we may well ask whether enough selenium is present in ordinary diets, either as inorganic selenides or as organic compounds, to affect human health—a question that public health authorities should investigate more thoroughly.

Columnist Arthur W. Galston teaches biology at Yale University.

Wilderness Expeditions

in association with FRIENDS OF THE EARTH, is arranging trips to these and other wild places. Prices include air fare.

☐ **Micronesia**
May 4-June 2, $1,834
with Robert Wenkam

☐ **Northern Greece**
May 20-June 16, $1,645
with Eric Schindler

☐ **Kenya's Outback**
June 1-22, $2,084
with Gordon Wilson

☐ **Peruvian Andes**
July 5-31, $1,456

☐ **Kashmir**
August 3-September 1, $1,802
with Dr. Robert L. Fleming, Jr.

☐ **Nepal: East of Everest**
November 9-December 15, $1,872
with John Milton

MAIL TO:
Wilderness Expeditions, Inc. Dept. NH274
230 Park Ave., New York, N.Y. 10017
Please send your 1974 newsletter to:

Name
Address
City State Zip

ELEGANT SIMPLICITY FOR THE HOME OR OFFICE, OR AS A PERFECT GIFT IDEA

BONSAI **Hardy, Beautiful! Imported from Japan.**

A living miniature tree. Twenty-years old complete in its own stoneware planter, with instructions on care. These amazing values come to you from Heirob Bonsai Nursery, America's largest importer of Bonsai trees.

12" Japanese Pine, 10" Grecian Boxwood 8" Japanese Elm, 8" Japanese Flowering Quince or 8" Blue Moss Cypress **$34.50** each/**$62.50** for two/**$150** for all five, *delivery included.*

We Ship to Canada

HEIROB BONSAI NURSERY
Willowemoc Rd., Livingston Manor, N.Y. 12758
(914) 439-5706 Phone Orders Accepted

☐ 12" Japanese Pine ☐ 8" Japanese Elm
☐ 10" Japanese Cedar
☐ 8" Blue Moss Cypress ☐ 10" Grecian Boxwood
☐ 1 Tree @ $34.50 ☐ 2 Trees @ $62.50
☐ All 5 for $150.00 ☐ Complete Catalogue

Enclosed is my check or money order for $ including sales tax, if any.
Bill my credit card account for the full amount of $.
Plus sales tax, if any.
☐☐☐ ☐☐☐ ☐☐☐ ☐ ☐☐☐
Expiration Date
Name
Address
State Zip
City
Signature

This is for me.

NATURAL HISTORY

J118

○ I want to join The American Museum of Natural History and get 10 lively issues of **Natural History** with my one-year membership*

○ I want to give **Natural History** and a one-year Associate Membership in the Museum* to somebody else who cares.

○ I want to splurge and do both.

○ I enclose payment ○ Bill me later @ $8 per subscription

*I understand that each membership-subscription includes: free admission to the Museum *plus* two bonus books a year *and* a discount at the Museum Gift Shop.

My Name

Address

City State Zip

○ New subscription ○ I prefer 2 years at $15

○ Renewal ○ 3 years at $21

send gift subscription to:

Name

Address

City State Zip

Sign gift card from

○ I prefer 2 years at $15 ○ 3 years at $21

FIRST CLASS
PERMIT NO. 4946
DES MOINES, IOWA

BUSINESS REPLY MAIL
No Postage Stamp Necessary if Mailed in the United States

POSTAGE WILL BE PAID BY—
NATURAL HISTORY
P. O. Box 5000
Des Moines, Iowa 50306

This is for the birds

And the long-vanished dinosaur. And the blue whale. And the planet Jupiter and Peking Man and seashells.

This is for you, too. All 20 buildings and 1,100,000 square feet of floor space at The American Museum of Natural History are for you (and your friends and your students and your teachers as well). It's your New York City wildlife preserve—and we hope you'll safari through it often.

We have 23,000,000 separate items to show you. Many of them have been dug out of layers of earth, layers of centuries, layers of misconceptions. Many of them represent the proudest works and the essential spirit of our own species: Man.

Neither the Museum nor its magazine, however, is content merely to study and marvel over past achievements. We care too much—as these pages will show you—about preserving our natural resources today, about building a world where man and all his fellow creatures can safely flourish tomorrow.

Won't you join us? Become an Associate Member...and take frequent advantage of the free admission that comes with your membership. Subscribe to Natural History...and let us send you a fresh and lively look at the world ten times a year...plus two books selected for their contribution to our knowledge of the natural world.

Or give a membership-subscription to someone you know who shares your concern for all living creatures. You can do either or both simply by filling out and mailing the postpaid, preaddressed card bound over this page.*

We can't think of a better way to spend $8. Or a surer way to get much more than your money's worth in return.

* If the card is already gone, just address your order to Natural History, P. O. Box 5000, Des Moines, Iowa 50306. Please include zip codes with addresses. And enclose your check for $8 for each one-year subscription/membership, unless you prefer to have us bill you.

Natural History THE AMERICAN MUSEUM OF NATURAL HISTORY
Central Park West at 79th Street, New York, N.Y. 10024

Celestial Events

by Thomas D. Nicholson

Sun and Moon February is one of those rare months in which one of the moon's four phases is missing. Full moon occurs on the 6th, last-quarter on the 13th, and new moon on the 22nd. But the preceding first-quarter moon fell in January, and the next will fall on March 1; the full moon again on March 8 and last-quarter on March 15. The moon will be a prominent evening object from about February 25 (when it is an early crescent) until mid-March (when it will rise at midnight or later). And the moon will introduce you to the planets when it is near Venus on February 19, near Mars on February 28, and near Saturn on March 2.

The sun is about as high in the sky now and remains there as long as it does in late September, but the weather hardly reflects that fact. Nights are growing shorter, but are still longer than days, and the Northern Hemisphere air mass is still cooling down.

Stars and Planets We still have two planets well placed in the evening sky. At dusk, you will find Mars high in the south, bright and reddish in color but nowhere near the brilliance it had last fall. Saturn is well up in the southeast, brighter, and well to the left of Mars. By midnight, Mars will have already set and Saturn will be low in the western sky.

The elusive Mercury is also an evening star in mid-February, but it enters the morning sky toward the end of the month and will not be well placed for viewing until after mid-March.

Venus should be very easy to find in the morning sky. Look for it in the southeast, in the dawn glow preceding sunrise. And after the first week of March, Jupiter, too, is in the morning sky, to the left and lower than Venus, closer to the rising sun.

February 15: Mercury begins to move westward (retrograde) on its way toward passing between the earth and the sun.

February 18: The moon is at apogee, farthest from the earth.

February 19: Look for Venus before sunrise this morning. It will be near the rising crescent moon, in the southeast.

February 24: Mercury, in inferior conjunction, passes between the earth and the sun and enters the morning sky.

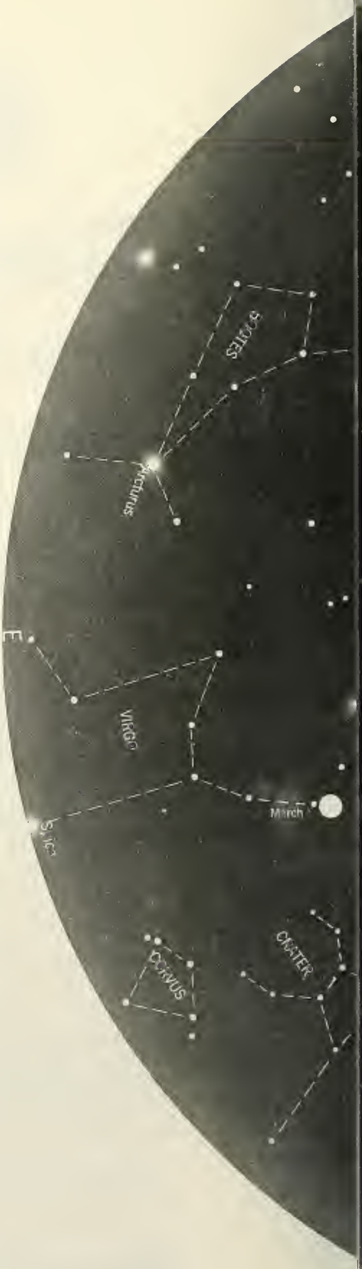
February 27: Venus is at greatest brilliancy as a morning star. Saturn ends its westward (retrograde) motion through Orion (near Gemini) and begins to move left (to the east) again.

February 28: The bright object near the first-quarter moon is Mars. The moon will be nearest the planet about 8:00 P.M., EST, so close that it will cover Mars in more northerly areas of America and Asia. Thereafter, the moon will separate slowly to the left.

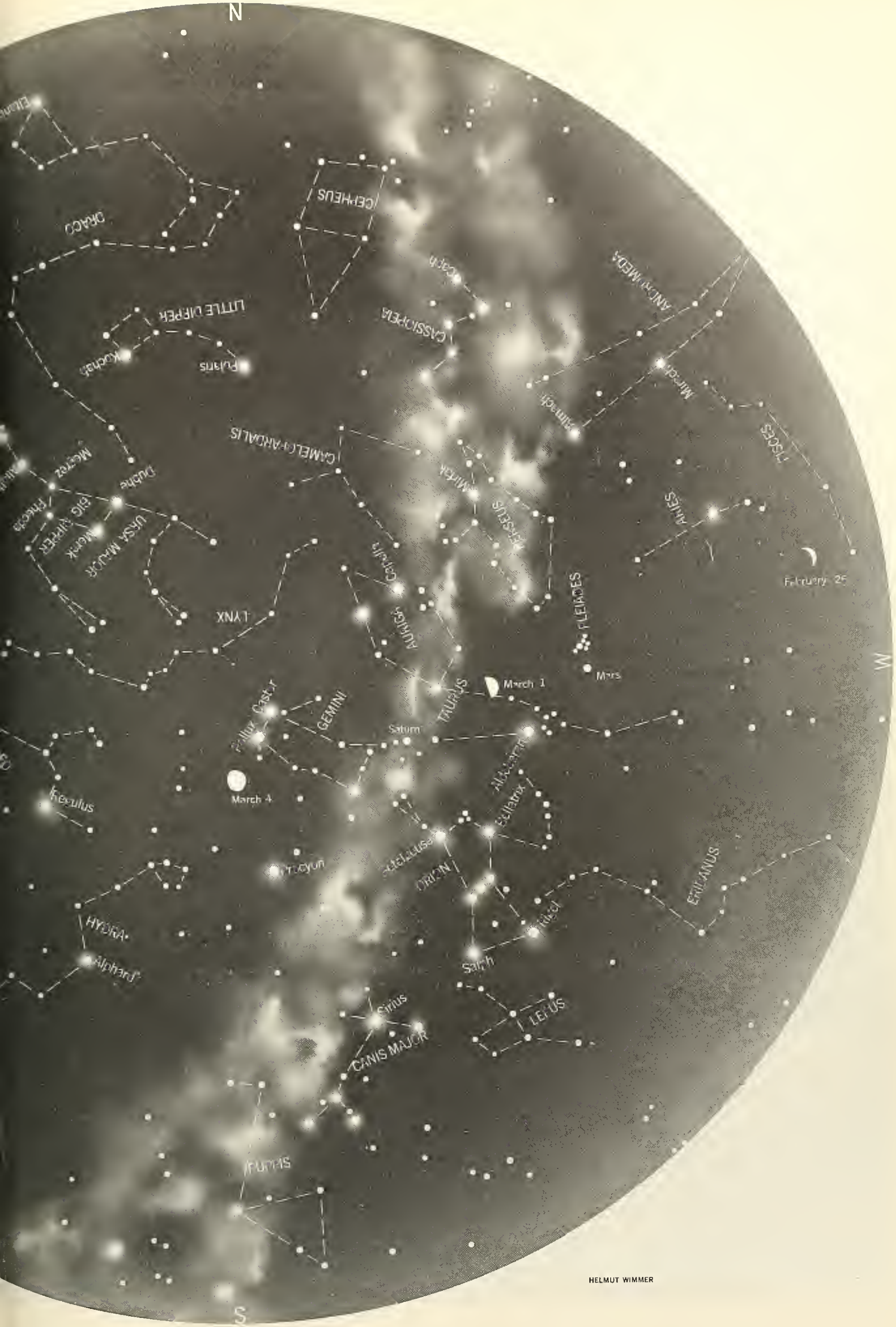
March 2: Mercury and Jupiter are in conjunction, but they rise too late in the morning to be easily seen. Saturn, this evening, will be very near the bright gibbous moon, closest at about 6:00 P.M., EST. Again, as with Mars, there will be an occultation as the moon covers Saturn in more northerly regions.

March 6: The moon is at perigee, nearest earth.

March 8: Mercury ends its retrograde motion.



★ Hold the Star Map so the compass direction you face is at the bottom, then match the stars in the lower half of the map with those in the sky near the horizon. The map is for 10:15 P.M. on February 15; 9:25 P.M. on February 28; and 8:25 P.M. on March 15; but it can be used for about an hour before and after these times.


N
Eltanin
DRACO
CEPHEUS
LITTLE DIPPER
Kochab
Polaris
Caph
CASSIOPEIA
ANDROMEDA
Mirach
Almach
PISCES
CAMELOPARDALIS
Megrez
Dubhe
Phecda
BIG DIPPER
Merak
URSA MAJOR
Mirfak
PERSEUS
ARIES
February 25
Capella
AURIGA
LYNX
PLEIADES
Mars
W
March 1
TAURUS
Castor
Pollux
GEMINI
Saturn
Aldebaran
March 4
Regulus
Bellatrix
Betelgeuse
Procyon
ORION
ERIDANUS
HYDRA
Rigel
Alphard
Saiph
Sirius
LEPUS
CANIS MAJOR
PUPPIS
S

HELMUT WIMMER

"Scal

by John H. Heminway, Jr.

hings that shuffle and lurk....”

Eyelids of Morning: The Mingled Destinies of Crocodiles and Men, by Alistair Graham and Peter Beard. *New York Graphic Society, $22.50; 260 pp., illus.*

When Isak Dinesen, author of *Out of Africa,* addressed the American Academy of Arts and Letters on January 28, 1959, she directed her audience's attention to an old English town surrounded by three walls, in each of which was a gate. Above the first gate was inscribed: "Be bold"; above the second: "Be bold"; above the third: "Be not too bold."

This great lady was giving a clue to her life. With uncertain spirit she had determined to write of the human spirit and was setting the perimeters to her own bold risk taking, giving an insight to her genius as a stylist. Her youthful craving to impress her will and her being upon the world, to make the world her own, had been transformed at midlife into a longing to be able to accept, to give herself over to the universe. Nevertheless, she doubted whether such acceptance was any less bold.

This quiet poet was cleverly avoiding the word "taste," which on an artistic level translates to mean restraint. Nonetheless she was suggesting that in writing, excessive forcefulness colors a work with falseness, causes buffoonery where laughter is more effective, creates agony where pain would be more eloquent. "Be bold, be bold, be not too bold."

It is excessiveness that steals perfection from Alistair Graham and Peter Beard's monumental *Eyelids of Morning.* At its best Beard's boldness results in a fantastic blend of Victoriana and psychedelia; when it is forced beyond its subject, it foolishly dwarfs Graham's exceptional text. Quite right of Beard to create a forest of visual comment

FLY THE AFRICAN EXPRESS.

It's New York to Dakar non-stop.
It's the greatest way to the last great continent.
It's Air Afrique. The African airline that knows Africa best.

Air Afrique's African Express jet adventures-off from Kennedy every Saturday at 6 P.M. Its destination: Dakar, and then on to Robertsfield/Monrovia, Abidjan, Lome, Douala, Libreville, and Kinshasa.

But Africa begins in the sky on Air Afrique. Our food is the finest African cuisine. Our stewardesses are dressed in magnificent native fabrics (one of Africa's finest arts). And our friendship is just a hint of what you'll find when you land.

Discover Africa. Our coupon can bring you closer. Our African Express can bring you there.

AIR AFRIQUE

Air France, General Agent. Box DC8
New York, N.Y. 10011
Please send me information about
Air Afrique's Africa immediately.

Name__________
Address__________
City__________State__________
Zip__________Phone__________
Travel agent__________
Or call any Air France office. RK-NH-2-74

Air Afrique's fleet now features DC-10's clean-powered by General Electric jet engines.

about the croc, but not to threaten insight with mockery, art with camp, humor with the in-joke.

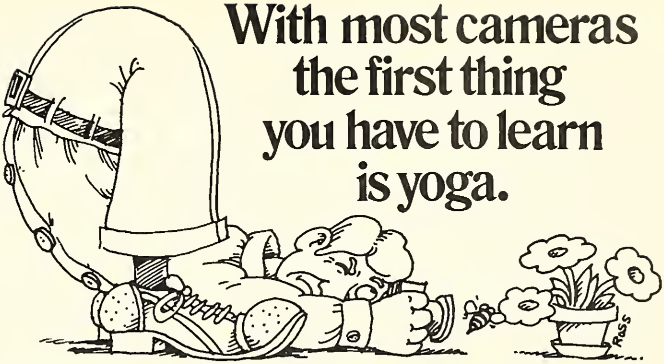
Still, *Eyelids of Morning* ranks for me as one of the most original commentaries ever written about an expedition, and I shall not hesitate to make sure that it brightens the tables of friends, particularly those whose religious acceptance of the principles of conservation need shaking. As a partnership between writer and scientist, between photographer and collector of the bizarre, this giant book raises the printed page to a level of sensation just short of the tactile; it is a three-ring circus of cartoons and cadavers, firm bosoms and bursting bowels, science, philosophy, and the absurd. The effect on the reader is a visual battle of concentration—where to settle one's eyes, whether to whimper or laugh, which page to cover with vomit. Conspicuously absent is each copy's own vial of putrefying croc smell or dried blood dribbled onto a few selected pages. Still, even the romantic and the faint of heart will find much to glory about in these pages.

Eyelids of Morning is the account of a three-year expedition at Lake Rudolf to compile data for the Kenya Game Department relating to "the essential biological facts of . . . its crocodile population." Alistair Graham was directed to "fix a value for the ratio of males to females, find the proportion of the whole population represented by each age group, study the rate of individual growth, their food and manner of getting it . . . to estimate their potential for reproduction and account for the agencies of mortality that limited their population . . . to discover why the population distributed itself around the lake the way it did and . . . [to discover] the effects man's planned intervention would have." The project, calling for the killing of 500 specimen crocs, required ingenuity to cope with the severe conditions of the phlegmatic lake and the sinister life-views of crocodiles. For food, Graham and Beard relied on Nile perch fried in sand, supplemented by Ritz crackers, pickles, and Hellman's mayonnaise (inspiration of Andy Warhol who adds his signature to descriptive photographs).

As a writer, Graham has intuitive taste when dealing with his tales of personal adventure. Not for him the boasts, the "firsts," the absorption in victories. He has a deep aversion to taking himself too seriously; for example, when he is bitten by a spitting cobra on North Island, isolated from all help, he acknowledges that he saved his life by kicking out at the snake "can-can style," thus preventing the fangs from piercing his skin too deeply. Later when their overloaded boat is swamped in the vicious afternoon sea, far from land, he studies his own panic as if it were a croc embryo in a test tube. Graham's outlook proceeds from his aversion to man's blundering and self-righteous deceit. Knowing that his study will come to naught, he is brief in outlining his findings in this book. With little sympathy for higher motives, he makes it abundantly clear that in no way should his intentions be considered altruistic. He concludes that most conservationists are consumed by "the worship of a lost childhood." He makes only one concession to them by sharing their belief that in wastelands such as Lake Rudolf there are "beautiful things . . . truthful things." For him the creation of national parks is not a solution to nature's destruction by man; it is, in fact, a symptom of sublime destruction still to come. Graham's style is lucid and often graceful, never boring; it fails only occasionally when he pumps it up with pretentious and unnecessary quotations.

Graham establishes that Lake Rudolf supports at least 14,000 crocodiles. Strangely, only 5,500 of these are mature. In spite of an extensive shoreline on the west devoid of crocs, he postulates that the lake's croc population shows signs of overcrowding: at Lake Rudolf crocs are requiring twice as long to mature as in other lakes of Africa, and sizes of clutches here are considerably smaller than in nests elsewhere. He leaves us with a series of imponderables. Why does Lake Rudolf support such a small proportion of adults? Why are the stomachs of so many crocs empty when the lake is so rich in fish life?

What distinguishes the text of this so-called travel book from the many written before and others sure to follow is one chapter—"August's Beans." It is in this chapter that we recognize Graham for what he is: not an outsider come to observe and



With most cameras the first thing you have to learn is yoga.

Most cameras give you the standard eye-level view of the world and that's all. Which means if you want to shoot from some less conventional perspective, you've got to exercise first. It's that tricky.

But with a really good camera you get a selection of interchangeable viewfinders. The eye-level kind that comes with the camera. And a waist-level viewfinder that takes care of the low-angle and overhead shots. And even a magnifying viewfinder for the times when everything depends on perfect focusing.

If you choose a camera that offers a selection of viewfinders, you can be pretty sure it's a good one. And if you want to be *absolutely* sure, you can get a Miranda. After all, the better your camera is, the easier it is to take good pictures.

MIRANDA®

AIC For details, write: AIC Photo, Inc., Dept. FB, Carle Place, N.Y. 11514.
In Canada: Kingsway Film Equipment Ltd., Ontario.

Discover the Republic of South Africa.

Thot's the title of o fabulous new book printed by the South Africon Tourist Corporation.

It's forty-eight pages long ond contoins 137 photogrophs all in beoutiful color. See our wildlife, our spectoculor scenery, our flora, our cities ond our people.

satour

"Discover the RSA" is yours free of chorge. Moil this coupon to the South Africon Tourist Corporotion.

South African Tourist Corporotion
610 Fifth Avenue, New York, N.Y. 10020
9465 Wilshire Blvd., Beverly Hills, Calif. 90212

Name________________

Address________________

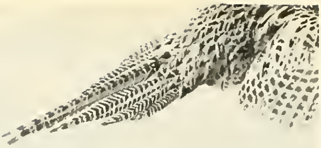
City________ State________ Zip________

NH 11

dictate, but a Kenyan himself, a sensitive observer without preconceptions of what is to happen, a man who does not need binoculars or field glasses or car windows to see through, or tents to sleep in or interpreters to insulate him from the men with whom he is to share the "hardest work." Unlike Lake Rudolf's European discoverers, Count Teleki Von Szek and Ludwig Von Hohnel, who were quick to berate the manners of the indigenous peoples, Graham responds to them like a man who wants to understand them. At the end of a long association with his Turkana helpers he naturally expects a friendly goodbye. Instead they accuse him (unjustly) of deception. He is indignant at first, but anger gives way to reflection when he realizes their rebuff is a symbol. He is beginning to sense the error of his thinking, the white man's thinking. He had always expected his study to benefit those people who live next to crocodiles. But the Turkana are strangely indifferent to protection from crocs although these latter are in the habit of dining regularly on Turkana children, women, and elders. In addition, the Turkana have no desire to eliminate famine, fighting, and pestilence from their world; inversely, if they could, they would catch the last fish in the lake, snare the last bird on the shore. Since they do not possess the "paleface's" sense of guilt, Graham asserts conservation is for them meaningless.

Here is where Graham finally deposits the reader: at a pitiless view of the white man's blundering through nature. He despises the creation of a national park on the eastern shore of the lake. But since he fails to offer other choices he sounds like a man insisting that sex be banned without offering an alternative. Leave all the crocs and the Turkana alone he says; who are we to judge the value of their lives? Graham knows that his words, like all regrets in Africa, have come too late. He sees the future already breaking the silence at Lake Rudolf, threatening it with fences, fish factories, and "do-gooders." Of course, Graham admits, he is a part of the blundering future himself: this book—its illustrations and its text—is a sardonic profession of guilt. His 500 dead crocs are merely the beginning.

The authors have created a sym-



Because they're birds and they're free! So you have to change your photo habits. One ingenious solution is a zoom lens. It gives you a fast change of focal lengths without moving the camera from your eye.

The Vivitar Automatic Zoom lens goes from 85 to 205mm, opens up to an impressive f3.8 and isn't any larger than most standard 200mm lenses. The highly sophisticated optical design has 13 elements in 9 groups. The Vivitar Automatic Zoom will fit the automatic mounts of the Nikon F, Pentax, Nikkomat, Mamiya/Sekor, Minolta and Canon cameras.

See a demo at your photo dealer or write for test reports by leading photo magazines.

Vivitar Zoom lenses

Marketed in the U.S.A. by
Ponder&Best, Inc.,
1630 Stewart Street,
Santa Monica, California 90406.
In Canada: Precision
Cameras of Canada, Ltd.

Why don't birds stay where they are while you change lenses?

TRAVEL THE WORLD OF LINDBLAD

Explore the world's largest "highway"...

THE AMAZON RIVER

Lars-Eric Lindblad offers two truly exciting expeditions that will take you along the entire length of the mighty Amazon. Very few people have ever seen this dense jungle world as you will, in great comfort aboard the air-conditioned M/S Lindblad Explorer.* You will be exploring the river in Zodiac rubber rafts, listening to howler monkeys, and seeing the pink dolphin at play in shallow waters. You will visit primitive tribes on the verdant shorelines and seeing nesting sites of many species of turtle. Of great interest will be the hundred and more species of forest birds and twice that number of tropical fish. You will pause at Manaus, the capital of the Amazonas and in the river's remote upper regions you will find the Yagua Indians, whose life has hardly changed since the settlers first arrived. The M/S Lindblad Explorer is operated in the famed tradition of the Swedish American Line. These two expeditions are scheduled for October and November of 1974. Please write for our informative brochure.

LINDBLAD TRAVEL, INC.
Dept. NHE 274
133 East 55th Street, New York, N.Y. 10022, (212) 751-2300

*Panamanian registry

Start your Holiday Abroad in beautiful Belgium.

And enjoy $75 worth of free treats during Belgium's Bonus Days.

The warmest welcome in Europe, plus a little of everything you come to Europe for make beautiful Belgium the perfect start for any holiday.

Sabena's Belgium has lush countryside dotted with stately chateaux, lovely medieval cities of art and architecture, museums richly hung with Flemish masters; and cosmopolitan Brussels, the "capital" of modern Europe.

Sabena and Belgium have a way to make your holiday even more beautiful. Belgium's Bonus Days offer visitors over $75 worth of special treats—free theater tickets, discounts for dining and sightseeing, half-fare train excursions, gift coupons and more—all compliments of the Belgian National Tourist Office.

Sabena offers you dozens of ways to discover beautiful Belgium and the rest of Europe plus the Middle East and Africa. Learn about them in Sabena's Holiday Abroad tour catalog, 32 colorfully illustrated pages of great reading about exciting Holiday Abroad adventures on three continents.

For your Holiday Abroad catalog, and information on Belgium's Bonus Days, call Sabena, mail the coupon, or see your travel agent.

HOLIDAY ABROAD
SABENA
belgian world airlines

Sabena Belgian World Airlines
Holiday Abroad Manager, Dept. H
125 Community Drive
Great Neck, N.Y. 11021

Please send me the new Holiday Abroad tour catalog and information on Belgium's Bonus Days.

Name ________________________________
Address ______________________________
City ______________ State ________ Zip ______
My travel agent is ________________________

SUPER pilot
time
Zeit
EV LW

to get
better pictures
choose the better
"picture taker"

Serious photographers depend on a hand-held exposure meter for the accuracy, sensitivity and reliability they must have for their color and black & white shots. The SUPER PILOT CdS, by world-famed Gossen, ideally fills their needs. Try one and you'll see how a fine exposure meter helps 'take' better pictures.

world famed
GOSSEN®
SUPER PILOT
CdS EXPOSURE METER

SPECIFICATIONS:
The **Super Pilot CdS** accurately measures reflected or incident light; two full measuring ranges: Normal and Low Light Scales; ASA 6 to 12500; f/1 to f/45; 1/1000 sec. to 2 hrs; EV − 6 to + 24; Cine from 8 to 128fps.

At better photo dealers or write for literature.
KLING PHOTO COMPANY
P.O. Box 1060, Woodside, N.Y. 11377
DIVISION OF Berkey PHOTO INC

TRAVEL THE WORLD OF LINDBLAD

Lindblad's spectacular Explorers' Tour to
CENTRAL ASIA & MONGOLIA

Imagine spending nights under the stars on the Gobi Desert in a Yurt, a Mongolian tent. Imagine roaming around old mosques and bazaars in the ancient city of Bukhara, hardly changed since five centuries ago.

Or exploring the wonders of Samarkand, the "Jewel of the Desert" with its memories of the greatest Mongol of them all, Tamerlane. Imagine covering remote regions of Siberia and Mongolia, meeting many different friendly races, languages, customs and styles of architecture which make up the complex called the U.S.S.R. And finally an evening at the ballet in Moscow. These are only a few of the highlights of this immensely popular Explorers' Tour. The first of ten tours in 1974 is scheduled to depart on June 6. Please send for our informative color brochure.

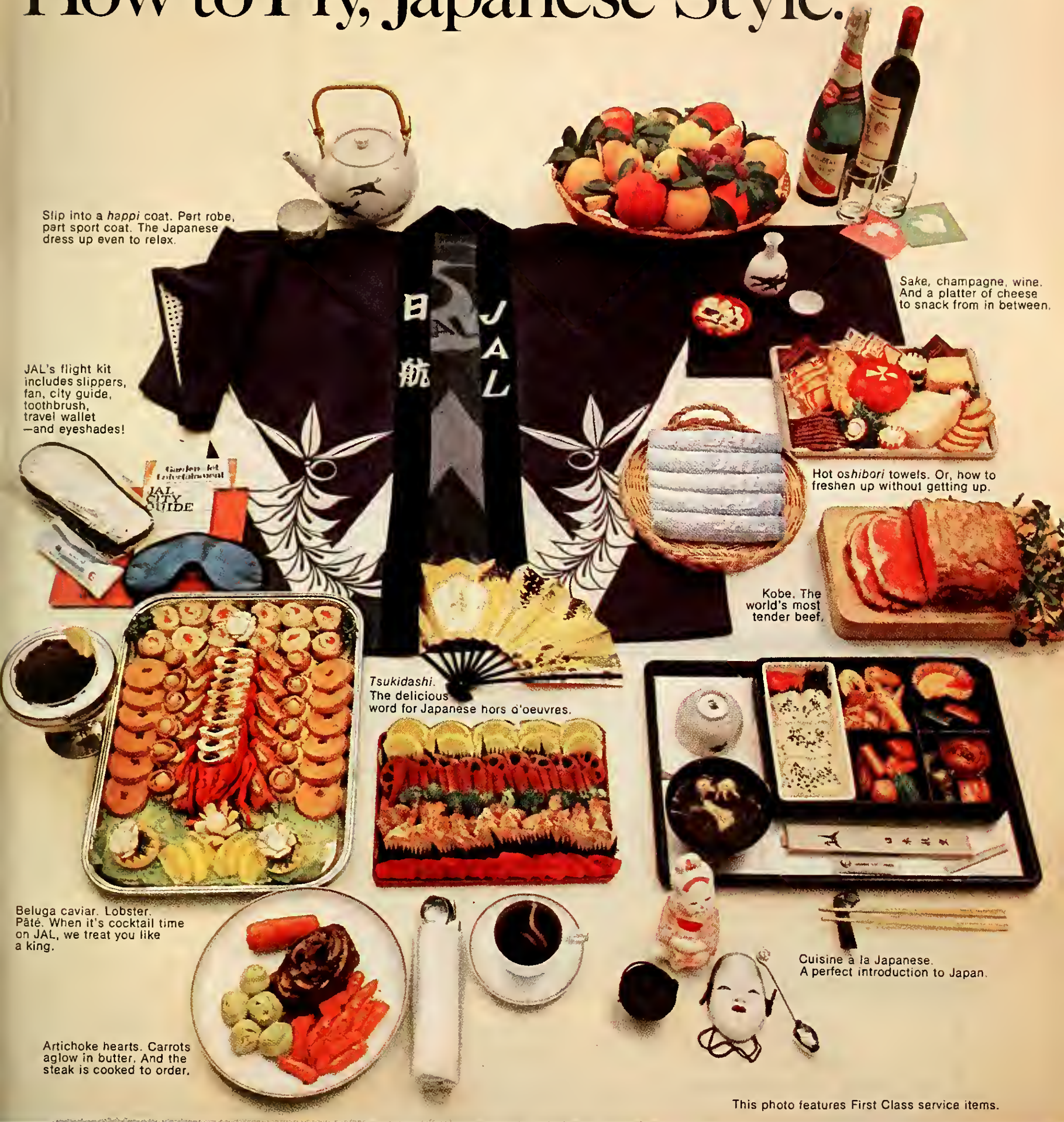
LINDBLAD TRAVEL, INC.
Dept NHA274
133 East 55th Street, New York, N Y 10022
(212) 751-2300

bol out of this scaly man-eating denizen of murky waters. To save the crocodile for posterity forces man to examine the aims of conservation with far more scrutiny than if the animal in question were, let us say, a panda. What does the crocodile contribute to nature, apart from adding one more element to its diversity? Who needs such a hard-skinned, loathsome man-eater? The sight of hundreds of rotting crocs is therefore hardly revolting; it peels the layers of sensibilities off sensitive readers, unconsciously suggesting to them the point at which bloodlust is acceptable.

Graham fast asleep beside a giant Nile perch, Beard writing his journal while tucked inside a croc's gorge or miming *rigor mortis* beside dismembered crocodiles: are these just for laughs? Probably. Who are the authors making fun of with the ornately detailed chapter descriptions, beautiful imitations of Victorian originals? Themselves. What do Richard Lindner, Andy Warhol, Francis Bacon, Charles Addams, and Saul Steinberg add to our knowledge of crocs at Lake Rudolf? Precious little. Art and the absurd are Beard's cryptic means of rejecting good intentions and reality.

One of the first pictures in the book is of two Turkana weighing a dead croc from a large wooden tripod, all reflected in the lake. The picture has been childishly inverted (in spite of the caption, "Right side up"); in it reality is only a reflection and vice versa. Here I found a clue to the book: beauty is to be tossed aside with an "ugh," heroism sublimated, reality and opinion inverted—for hardly any reason. This occasional gimmickry seems to exemplify Beard's unnecessary self-assertiveness, telegraphing the pretentiousness of, for instance, a double spread of a heaving bosom,

How to Fly, Japanese Style.



Slip into a *happi* coat. Pert robe, part sport coat. The Japanese dress up even to relax.

JAL's flight kit includes slippers, fan, city guide, toothbrush, travel wallet —and eyeshades!

Sake, champagne, wine. And a platter of cheese to snack from in between.

Hot *oshibori* towels. Or, how to freshen up without getting up.

Kobe. The world's most tender beef.

Tsukidashi. The delicious word for Japanese hors d'oeuvres.

Beluga caviar. Lobster. Pâté. When it's cocktail time on JAL, we treat you like a king.

Cuisine à la Japanese. A perfect introduction to Japan.

Artichoke hearts. Carrots aglow in butter. And the steak is cooked to order.

This photo features First Class service items.

We once asked some of our flight guests what they liked most about flying with us.

Surprisingly, it wasn't any of the comforts or delicacies above.

In fact, it wasn't what we did so much as how we did it.

They spoke of being pampered. Of the way our hostesses in kimono smile.

Small things, of course. But in a world that worships the mammoth, the small has a way of making up in gleam what it lacks in size.

At JAL, we glory in the small things of life. From our first hello to our last *sayonara,* we take the small attentions and courtesies so much for granted, they are our way of life.

It's a way of life practiced by us and our ancestors of generations beyond number.

In that sense, you could say we've been practicing how to fly for a thousand years and more.

JAPAN AIR LINES

JAL

NH-0274

Japan Air Lines
P.O. Box 888
Burlingame, California 94010

I'd like to fly Japanese style. Please send me your free booklet with all the details.

Name____________________________

Address__________________________

City______________State__________Zip________

My travel agent is____________________

Please have a travel consultant call me at__________________

NEW . . . MAUPINTOUR HOLIDAY!
EGYPT/UPPER EGYPT/LEBANON/SYRIA/CYPRUS/ISRAEL

MIDDLE EAST

JOURNEY INTO TIME where it all began. See Cairo, the Nile, Pyramids, Sphinx, Luxor, King Tut's Tomb, Karnak, Thebes, Beirut, Byblos, Baalbek, Dog River, Damascus, bazaars, Nicosia, Palestine, Judea, Samaria, Galilee, the Jordan, Jerusalem, Dead Sea, Jericho, Masada, Hebron, Bethlehem, Nablus, Sebastia, Megiddo, Tiberias, Nazareth, Safed, Acre, Haifa, Caesarea, Tel Aviv. **ONLY $1154** plus air fare. Small party, best hotels, resorts. Special events. Fly *TWA*. **ASK YOUR TRAVEL AGENT** for the new *MAUPINTOUR MIDDLE EAST* folder or write Maupintour, 270 Park Ave., New York, New York 10017. Telephone 212/687-7773.

our 23rd year of quality tour operation **Maupintour**

ASK ABOUT THESE MAUPINTOUR HOLIDAYS:
☐ Spain/Portugal ☐ Morocco ☐ Greece/Aegean Isles
☐ Middle East ☐ Egypt/Luxor ☐ Italy/Lakes/Sicily
☐ France ☐ The Alps ☐ Bavaria/Austria ☐ Balkans
☐ Germany/Rhine ☐ Middle Europe ☐ British Isles
☐ Dalmatia ☐ Scandinavia ☐ North Cape Adventure
☐ Europe Continental ☐ Soviet Union/Eastern Europe
☐ South Pacific ☐ Orient ☐ South America ☐ Africa

TRAVEL THE WORLD OF LINDBLAD

BOTSWANA WING SAFARI,

another "first" in Lindblad's world-wide explorations.

There exists a fascinating country in southwest Africa known as Botswana (formerly the Bechuanaland Protectorate). It is perhaps one of the few remaining pockets of unspoiled nature left in this world. All your travel into this verdant nature paradise will be done by sturdy Land Rovers as well as by small planes. You will see sizeable animal herds of all kinds, visit National Parks and, because the Etosha Game Reserve is one of the finest in the world, we have decided to include it on our itinerary. The opportunities for excellent nature and animal photography are endless. Unlike East Africa, people are permitted out of their Land Rovers to photograph the animals. Your nights will be spent in restful and well-managed camps and lodges. And because this twenty-day Botswana Wing Safari is a very popular Safari, we suggest you write at once for our informative color brochure.

LINDBLAD TRAVEL, INC.
Dept. NHS274
133 East 55th Street, New York, N.Y. 10022
(212) 751-2300

a confused photograph endorsed by the painter Francis Bacon, or model Naomi Simms's bikini-clad body on a dead croc, decorating an otherwise astounding bibliography. Beard simply forces this momentous book beyond its limits with glaring excesses until it begins to make fun not only of the reader but of itself.

I salute Graham for the intelligent and moving text of *Eyelids of Morning*, and I wish he had let his reader see the completion of his original and critical thoughts. Once again, as with *The End of the Game*, I am overwhelmed by Beard's creativity, by his catholic taste, by the curious mix of his expression. *Eyelids of Morning* is the result of immense talent too sure of itself. With only a mite less contempt and despair, a mite more positivism and control, this outstanding book could have been magnificent; its message enduring beyond its glossy cover.

John H. Heminway, Jr., author of The Imminent Rains: A Visit Among the Last Pioneers of Africa, *writes and produces films, many of them on Africa. He recently returned from running 500 miles of the Omo River in Ethiopia, the only permanent source of water for Lake Rudolf.*

BARE BONES, by Beverly Halstead and Jennifer Middleton. *University of Toronto Press, $7.95; 120 pp., illus.*

Bones mean different things to different people. Chewed by carnivores, collected and gnawed by porcupines, sucked for their rich marrow by man and other animals, engraved and carved by artists, used as amulets and strung into necklaces, and speculated over by witch doctors, bones are considered living tissues and organs by biologists and clinicians. Teeth are ground into a powder and dispensed as an aphrodisiac by the Chinese; sharpened bones pierce noses, lips, and ears as beautifying or terrifying ornaments; and bones are fashioned into skates, sleds, and trapping and hunting equipment. To some, bones conjure up museums (dinosaurs and other extinct animals), to others they symbolize

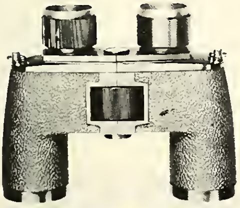
53 ORIENTALS - ONLY 10¢

VIET-NAM
MALAYA
INDONESIA
KOREA
INDOCHINE
THAILAND

Imported from strange lands of the mysterious Far East — this valuable collection of 53 genuine postage stamps from Borneo, Burma, Hong Kong, Malaysia, Nepal, Siam, Sarawak, Singapore, Viet Nam, etc. Supernatural Demon-God (half man, half bird), ferocious wild beasts, ceremonial dancers, weird oriental idols, many others. Guaranteed worth over $1.50 at standard catalog prices—all for 10¢! Also, fine stamps from our approval service which you may return without purchases and cancel service at any time — plus big FREE Illustrated Catalog.
Jamestown Stamp, C24NM, Jamestown, N.Y. 14701

WRITE ITALIC

Learning the Italic hand is more exciting with the PLATIGNUM ITALIC SET containing a fountain pen, five Italic nibs and our free introductory manual. It allows you to discover which nib widths best suit your developing hand and offers the convenience of having full nib range available for special purpose work. Only $4.50 at artist material, pen and craft shops as well as college bookstores or send check or money order to PENTALIC CORPORATION, 132 W. 22nd STREET, NEW YORK, N.Y. 10011. Add 50 cents to cover handling. State whether right or left handed... Nothing is more satisfying than learning to produce the beautiful thicks and thins that characterize the Italic hand and it's easy to do as the pen, held at the proper angle, does most of the work for you. So be a complete penman, own the PLATIGNUM ITALIC SET.



BUSHNELL 7x35 CUSTOM
Mfg. List $139.50 Postpaid $83.50

This is an example of the deep discount prices on high quality optics that is found in our FREE catalog. This catalog lists and illustrates an outstanding selection of camera lens, telephoto lens, telescopes, binoculars etc., plus valuable information on how to properly select them. Write for it today.

GIL HEBARD OPTICS
COURTHOUSE SQ., KNOXVILLE, ILL. 61448

Dalmatia under Sail

For people who love the sea and appreciate comfort, we have devised leisurely two-week voyages along the lovely coast of Yugoslavia in the spring and summer of 1974, aboard the new 40-passenger three-masted schooner *Adria.*

Detailed color brochure available from:
HANNS EBENSTEN TRAVEL, INC
55 WEST 42 STREET, NEW YORK, NY 10036
TELEPHONE (212) 354 6634

death and decay. Some scientists view them in terms of evolution-directed levers in locomotion, the architectural media of tension and strains, while others perceive them as organs of constant chemical interchange involved with hormonal activities, growth, and degeneration. Pathologists deal with bone tumors and vitamin deficiencies affecting bone and consider the involvement of bone in various diseases—acute inflammations and rheumatic diseases, syphilis, tuberculosis, and a host of others. Bones can be special nuisances to skiers, football players, racing drivers, ice hockey players, and the like, while they are the bane of parents and a boon to orthopedic surgeons.

Yet, with our instinct for individual survival and perpetuation of species, skeletons (and skulls, in particular), more often than not, convey to us the concept of past evolution and death. We live with an awareness of death, strengthened by rituals and institutionalized concepts of mortality, souls, and resurrection. Within their first decade, all Western schoolchildren know the pirates' "skull and crossbones." In some ancestor-worshiping societies inhumation is a temporary event followed by reburial of the bones when the community moves to another settlement.

The authors of this slim volume of 120 pages constitute an interesting duo: Halstead is a zoologist; Middleton is a medical artist. They perceive bones in some of the above contexts, bringing together a series of facts and anecdotes to interest the layman. The first and last pages of the text display children's cartoon strips, and there is a lot of entertaining stuff in between.

The book does not pretend to be all-inclusive, yet some of their choices and value judgments seem to be untenable. Halstead's zoological and geologic background can be blamed for the rather extensive treatment of dinosaurs, the cursory handling of human bipedalism, and the virtual absence of the excitement and fascination in *modern* bone-muscle biomechanics. If the aim of this book is to provide the layman with unusual, interesting, and "live" insights into dry bones, then the eight pages devoted to aspects of dinosaur evolution that every schoolchild learns (including

Share the Thrills of Exploring Outer Space!

$219.95 f.o.b. Hartford, Conn.
$15 Crating Charge

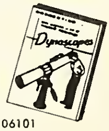
All DYNASCOPES, including this superb RV-6, 6-inch available on easy terms!

Now it's easy to join the thousands of serious amateurs who have discovered the excitement of exploring our mysterious universe. Your enjoyment begins right from the start, yet the challenges and rewards go on for years! And it's a hobby that can be shared at modest cost.

Choose From Many DYNASCOPES®

Picking a telescope to fit your needs and your pocketbook is simple when you select a DYNASCOPE — the same instruments used by more than 150 schools, colleges and observatories — and your satisfaction is guaranteed by a full-refund warranty.

FASCINATING GUIDE YOURS FREE!



Read these valuable facts before buying any telescope. Mail coupon or postcard for your complimentary copy of this helpful guide.

Criterion Manufacturing Co.
331 Church St., Hartford, Conn. 06101
® TM Registered U.S. Pat. Office

CRITERION MANUFACTURING CO., Dept. NH-45
331 Church St., Hartford, Conn. 06101
Please send your free Telescope Guide.
Name__________
Address__________
City__________ State__________

Marchal® JEWELERS

Give the World's Oldest Love Symbol.
shown actual size.

Since 2000 B.C., this Hieroglyph has been the symbol of secret love. Today, in 14K yellow gold, it still has the same meaning (translation enclosed with each gift).

Marchal Jewelers
745 Fifth Ave., Dept. NH274
New York 10022. (212) PL 1-3360

Please send the following, postage prepaid and gift-boxed. Satisfaction guaranteed. No C.O.D.'s.

Pendant	$42.
Smaller Pendant (not shown)	$22.
28" chain, 14K gold	$46.

Add $1. postage & handling for under $75. orders. N.Y. State add applicable tax.
☐ Enclosed is $1. for 121 pg. Gift Catalog only.

Name
Address
City State Zip

Master Charge, BankAmericard & American Express accepted. Give card name, number & signature.

Signature
# Exp. date

"Can only be compared to the earlier work of Audubon...

It is fitting that Arthur Singer, one of the world's most skilled delineators of birds, should illustrate the feathered gems that Skutch writes about in his excellent prose." —ROGER TORY PETERSON

The Life of the Hummingbird

by ALEXANDER F. SKUTCH
Illustrated in full color by
ARTHUR B. SINGER

7½" x 10¼". $9.95, now at your bookstore, or send check or money order to CROWN PUBLISHERS, 419 Park Ave. South, New York, N.Y. 10016

GIANT SHELLFISH, flightless birds and insects, oddly shaped plants...

are just a few of the strange developments fostered by generations of island breeding. Islands are natural laboratories for observing the effects of evolution, as shown in this "splendid volume.... Carlquist deals with most of the major evolutionary questions of the day."—Ernst Mayr, Museum of Comparative Zoology, Harvard University

ISLAND BIOLOGY
SHERWIN CARLQUIST

Copiously illustrated
$25.00

COLUMBIA UNIVERSITY PRESS
New York,
New York 10025

the usual pictures) seem a miscast effort for revealing the commanding attraction of paleontology. It is a pity that advantage was not taken of the recently renewed and increased public interest in human biology and primate evolution.

In the short section on "odd bones" there is also a strange obsession with penis bones, and the discussion takes on a rather questionable beer hall flavor displaying an obliviousness of the results of twentieth-century sex education available to most children.

Gross bone pathology always claims a bizarre fascination for the layman. The authors have chosen some interesting examples, but they are clearly out of their depth here (as they are when dealing with the pros and cons of evidence on the osteodontokeratic "culture"). Paleopathology may be a new discovery to the authors but it is an old subdiscipline, and most physical anthropologists are aware of pathological deformation of bones. Abnormal skeletal aberrations were, in fact, a particular concern of earlier paleoanthropologists, the majority of the more famous being anatomists, often medically trained. Osteoarthritis of Neandertals was not evinced by "medical men" but by anatomists (Drs. W. L. Straus and A. J. E. Cave) in 1957. The pathology observable in the Broken Hill (Rhodesian) Man is not as simple or accepted as stated, and everyone would not agree that the double impressions on some of the baboon skulls in the South African australopithecine cave deposits were "clearly made by the wielding of the long leg bone of an antelope."

The book contains numerous irritating errors of fact and interpretation, and a few touches of Ardrey and Morris. Nevertheless it is eminently readable, has delightful vignettes, and the many pages of illustrations are clear, attractive, and artistic. The authors have assembled many unusual aspects and snippets of osteology that most readers would have difficulty in locating in the literature. Again, although somewhat belabored, the data concerning French prisoners of the Napoleonic wars incarcerated in British prisons and the range of ingenuity expressed in carving bones are fascinating titbits of history. The chapters on bones in art,

JUST ONE HAND !

A completely NEW concept in gardening machines! The amazing 2-in-1 TROY-BILT® is not only a wonderfully better roto tiller, it's also a wonderful compost shredder-chopper! It turns your whole garden, however large or small, into a fabulously fertile "compost pile"! So easy to handle, even for ladies and older folks, you guide it with JUST ONE HAND! For complete details, prices, off-season savings, ask for free booklet. Write TROY-BILT Roto Tiller-Power Composters, Dept. 40352, 102nd St. & 9th Ave., Troy, New York 12180.

100 WORLDWIDE STAMPS ..only 10¢

GET this giant collection of 100 different stamps from the world over—Virgin Islands, Rwanda, Hungary, everywhere. New countries, new commemoratives, pictorials, topicals. Get Eisenhower memorial, giant lion, Unicef, others shown plus many more new, old issues. Colorful valuable stamps—wild animals, famous people, far places. Also stamp selections to examine. Buy any or none, return balance. Cancel service anytime. Rush 10c today for your valuable collection.
GARCELON STAMP CO., Dept. 2NHR, Calais, Maine 04619

The HOUSE of RINGS
creators of unusual fingerware
offers an extremely unique ring
THE
METEORITE RING
The only ring on Earth with a stone from outer space

MM

MF

MM sizes 8-12, sterling silver. $35
MF: sizes 4-10, sterling silver. $33

Send size and style with check or m.o. to: HOUSE of RINGS, Box 16003, Kansas City, Mo. 64112

TETON SCIENCE SCHOOL
Accredited 6 week coed high school field biology course. June 21 - August 1. Emphasizing collecting, identification, community analysis. Life zone approach. Research project, backpacking into wilderness areas. Location Grand Teton National Park—16 students. August 3 - 16 U. of California Extension, Davis. Field Ecology of Jackson Hole (6 units). 8th year operation. Write:
Box 1111,
Jackson, Wyoming 83001

as media and as tools, and the uses of bone for utensils, musical instruments, dwellings, toys, opium and snuff boxes, ornaments, and in witchcraft make the volume a worthwhile purchase. The subtitle states that it is "an exploration in art and science": the former is the meaty part of the book, while the latter is rather bare.

RONALD SINGER
University of Chicago

Erratum: The caption on page 30 of the January issue, referring to the far side of the moon, should have read: "This new view, the left third below . . ." The main point is that the back of the moon lacks the maria seen on the familiar surface.

WHEN YOU WRITE TO NATURAL HISTORY

about a change of address, renewal of subscription, billing, or any kind of adjustment, send the present address label from the magazine wrapper.

Moving? Please notify 6 weeks in advance.
You can use this form to tell us about a move or order a subscription.

Change of address—attach your address label in the dotted area and fill in your new address below, clip and mail to: Natural History Magazine. Membership Services, Box 6000, Des Moines, Iowa 50306.

A new subscription—Check box and fill in name and address below.

☐ 1 year—$8
☐ 2 years—$15
☐ 3 years—$21

(Add $2 per year to Canada and other non-U.S. orders)

Cut your old address label from magazine wrapper and attach over this area.
Fill in your NEW address below and mail to:
Natural History Magazine
Membership Services Box 6000
Des Moines, Iowa 50306

PLEASE PRINT H001

Name ______

New Address ______

City ______ State ______ Zip ______

FIFTY JUNGLE BUTTERFLIES $2.95
THIRTY EXOTIC SEASHELLS $1.95
FIFTEEN BEETLES—WORLDWIDE $3.25
EIGHTEEN GEM-STONES $2.25
PLUS giant Natural Hobbies Bargain List with many school projects and gift suggestions.
Dept.H,Collectors'Wonderland-Box 1170,N.Y.10008

Nikon wants you to see better

Nikon prism binoculars start with world-famous Nikon optics, made from Nikon optical glass. Lenses and prisms for right and left barrels are precisely matched and collimated, and the optical parallelism of both barrels is verified.

That's why with Nikon binoculars you enjoy brilliant, sharp, full-field viewing without strain or fatigue, even for long stretches. Now, find out how little more it costs to see better, longer. At Nikon camera dealers and selected optical departments. Write for literature Folio 18, Nikon Inc., Garden City, N.Y. 11530. Subsidiary/Ehrenreich Photo-Optical Industries, Inc. EPOI (In Canada: Anglophoto Ltd., P.Q.)

Nikon Binoculars

Send for this FREE record and learn how to speak a second language!

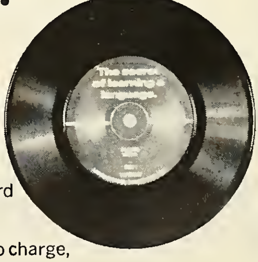
Send for a free Linguaphone Record and believe your ears.

Linguaphone will teach you a new language through the natural method of learning:

First you listen, then you understand, then you speak. It's the same method you used as a child to learn English.

Why not believe your ears? Our free record will prove to you that learning a foreign language is easier than you think.

Send for your free record now. There is no charge, no obligation at all!



FREE RECORD AND FOLDER

Linguaphone Institute, Inc. Dept. 11800
100 Park Avenue, New York, N.Y. 10017

I want to learn a new language quickly and easily, right in the privacy of my own home. Rush my FREE record to me, plus an illustrated folder that gives a complete explanation. I understand no one will call, and I will be under no obligation.

☐ Mr.
☐ Mrs. ______
☐ Ms.
Address ______
City ______
State ______ Zip ______
Please mark appropriately: I am most interested in:
☐ French ☐ Spanish ☐ Italian ☐ German
☐ Other ______

Linguaphone for Languages
A Service of Westinghouse Learning Corporation

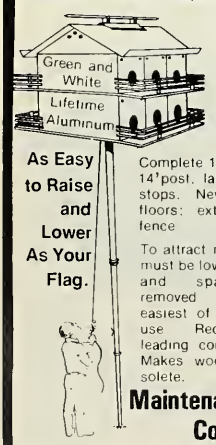
Join 60,000 League members who are creating a better environment. Membership entitles you to a free 10 x 13 inch limited edition wildlife print signed by artist-naturalist Charles J. Johnston, plus a year's subscription to *Outdoor America*.

Send $10 annual membership fee and selection of ruffed grouse or great horned owl numbered print to The Izaak Walton League of America, 1800 N. Kent St., Suite 806, Arlington, Va. 22209.

from the Izaak Walton League

World's Most Popular Martin System

Produced in the Purple Martin Capital



Trio Grandpa Martin System

As Easy to Raise and Lower As Your Flag.

Complete 12 cavity house. 14' post. lanyard and door stops. New. self-draining floors: extra high guard fence

To attract martins. houses must be lowered frequently and sparrow nests removed Trio is the easiest of all systems to use Recommended by leading conservationists. Makes wood houses obsolete.

Maintenance Free--Cool

A Purple Martin Can Eat 2000 Mosquitoes A Day

Only $49⁹⁵

Plus $2 postage and handling

Guaranteed Products Co.
Box 222N
Griggsville, Ill. 62340
(ILL. res. add 5% sales tax).

Additional Reading

AN ENERGY ORGY (Page 16)

The American Whaleman. E. P. Hohman. Longmans, Green and Company, New York, 1928.

The North American Buffalo. F. G. Roe. University of Toronto Press, Toronto, 1970.

Limits to Growth. D. H. Meadows et al. Universe Books, Inc., New York, 1972.

The Titanic Effect. K. E. F. Watt. E. P. Dutton and Company, Inc., New York. In press.

NORTHERNMOST PEOPLE (Page 24)

Book of the Eskimos. Peter Freuchen. Fawcett World Library, New York, 1969.

The Last Kings of Thule. J. Malaurie. Thomas Y. Crowell Company, New York, 1956.

The People of the Polar North. K. Rasmussen. Kegan, Paul, Trench, Trübner and Company, London, 1908.

Northward over the Great Ice. R. E. Peary. Frederick A. Stokes and Company, New York, 1898.

NEW ZEALAND'S ALPS (Page 34)

Elementary Seismology. C. F. Richter. W. H. Freeman and Company Publishers, San Francisco, 1958.

Plate Tectonics. J. F. Dewey. *Scientific American*, May, 1972.

Debate about the Earth. H. Takeuchi et al. Freeman, Cooper and Company, San Francisco, 1967.

OSCAR (Page 43)

Sanity, Madness and the Family. R. D. Laing and A. Esterson. Penguin Books Inc., New York, 1970.

Pragmatics of Human Communication. P. Watzlawick et al. W. W. Norton and Company, Inc., New York, 1967.

The Manufacture of Madness. T. S. Szasz. Harper & Row, Publishers, New York, 1970.

LIFE-GIVING OILS (Page 52)

Man and the Sea. B. L. Gordon, ed. Doubleday and Company, Inc., New York, 1972.

Between Pacific Tides. E. F. Ricketts and J. Calvin. Stanford University Press, Stanford, 1968.

Secrets of the Seas. W. J. Cromie and W. H. Amos. W. W. Norton and Company, Inc., New York, 1972.

THE SANDHILL CRANE (Page 62)

Conserving Life on Earth. D. W. Ehrenfeld. Oxford University Press, New York, 1972.

The Whooping Crane. F. McNulty. E. P. Dutton and Company, Inc., New York, 1966.

The Sandhill Cranes. L. H. Walkinshaw. Kingsport Press, Cranbrook Institute of Science, Bloomfield Hills, 1949.

Cranes of the World. L. H. Walkinshaw. Winchester Press, New York, 1972.

oneness

A subtle linking of man's religious symbols, delicately wedded together by the artisan.

14K with 24" chain $35.00
Sterling Silver $16.75

ISAAC SOLTES DESIGN NH
1923 S. McPherrin Ave.
Monterey Park, Calif. 91754
Check or Money Order / Money-back Guarantee

PEACEMAKER

There must be a place not far away from you with no noise, no crowds, no pollution. Let Old Town help you find it.

Write today for the free, full-color 1974 Old Town Catalog.

Old Town
CANOE COMPANY
20 Water Street
Old Town, Maine 04468

FREE!
(when you send 10¢ for mailing)
BRITISH NORTH AMERICA
STAMP COLLECTION

Get 14 spectacular mint issues from Antigua, Grenada, Turks & Caicos, etc., plus Giant Silver Stamp, other scarce Canada Commemoratives: Prince Edward Is., British Columbia & Vancouver Is., - more! Sent FREE to introduce World's most rewarding hobby. (We'll incude other exciting stamps for you to examine: buy any or none, return balance, cancel service anytime.) Send 10¢ for mailing today!

Kenmore, Milford BNA-553, N.Hamp. 03055

ESKIMO ART & ARTIFACTS

Our 40 page catalogue consists of photographs and prices of our current collection of contemporary and ancient Eskimo art and artifacts. The catalogue price is one dollar.

WALRUS IMPORTS ESKIMO GALLERY
Box 145
Kennebunkport, Maine 04046

SUMMER IN THE
WILDERNESS

Climb the Adirondack and Big Horn High Peaks.
Canoe voyageur routes in Northern Ontario.
Month long Wilderness Expeditions.
Basic and Advanced Survival Instruction.
Also Weekend and Special Trips:
Fall, Winter, Spring
Write for definitive brochure H:
North American Wilderness Survival School
205 Lorraine Avenue
Upper Montclair, N.J. 07043
Tel: 201-783-7711

LIVE IN THE WORLD OF TOMORROW...TODAY!

A BETTER LIFE STARTS HERE

(And our FREE CATALOG is packed with exciting and unusual ecological & physical science items—plus 4,500 finds for fun, study or profit . . . for every member of the family.)

"FISH" WITH A MAGNET

Go treasure hunting on the bottom! Fascinating fun & sometimes profitable! Tie a line to our 3½ lb. Magnet—drop it overboard in bay, river, lake or ocean. Troll it along bottom—your "treasured" haul can be outboard motors, anchors, other metal valuables. 3½ lb. Magnet is war surplus—Alnico V Type—Govt. cost twice our price. Lifts over 40 lbs. on land—much greater weights under water.

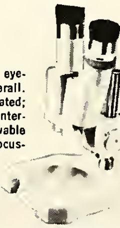
Stock No. 70,570E 3½ lbs. ....$11.50 Ppd.
Stock No. 60,215E 1½ lbs. ....$6.50 Ppd.

130 EXPERIMENTS IN OPTICS...

and photography! Optix® Experiments Kit is a complete optical & photography lab for 130 exciting experiments. Lets you recreate the periscope, telescope, microscope, kaleidoscope! Build a 35mm reflex camera with interchangeable lens system! Make, develop photographic film! Enjoy the fun and fascination of having your own optics lab. Fully illustr 112-pg manual, 8½x11", clearly explains usage of this stimulating kit's 114 precision engineered components.

Stock No. 71,646E ....$22.50 Ppd

STEREO MICROSCOPE AT ⅓ PRICE



Mfr.'s surplus! Paired 10x Kellner eyepieces w/rubber eyeguards & paired 3X color corrected objectives for 30X overall. Left side focuses independently. Good definition; collimated; coated optics; long working distance (var. 1½-4"); interpupillary adj: 55-80mm; extends 9-13" overall. Removable diffusing plastic stage; helical rack & pinion for smooth focusing; lockable head swings 360°. Lustra-coated metal, study vibrationless base. 3½ lbs. Imported. Hurry!

Stock No. 71,621E ....$59.50 Ppd.

AUTHENTIC ACUPUNCTURE MODEL

Learn first-hand about Asiatic needle probing from exact duplicate of models used in Red China. 11½" free-standing model clearly shows 12 all-important meridian lines and approx 500 specific points an acupuncturist must learn to pierce. Precise enough to serve as teaching aid for doctors, teachers & medical students. Fully illustr instructive 9-page bklt. See why this 5000 yr. old healing & pain removal method has had such impact on Amer. medicine. Polyethylene (rubberized).

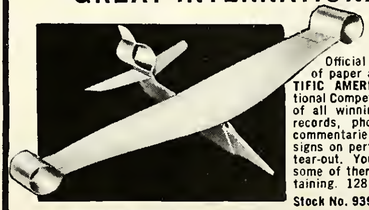
Stock No. 71,778E ....$12.00 Ppd.
Authentic Asian imported model Stock No. 71,850 ....$30.00 Ppd.

GIANT WEATHER BALLOONS—8′ OR 25′ DIAMETER

"Balls of fun" for kids, traffic stoppers for stores, terrific for amateur meteorologists. Create a neighborhood sensation. Great for decorations, launching radio controlled airplanes, scuba diving markers, etc. Amateur meteorologists use to measure cloud heights, wind speed and temperature. Made of thin neoprene designed to burst at high altitudes. Inflate carefully with vacuum cleaner or auto air hose; or locally available helium for high rise.

Stock No. 60,568E (8′ size) ...$ 2.50 Ppd.
Stock No. 60,632E (25′ size)....$13.95 Ppd.

GREAT INTERNATIONAL PAPER PLANE BOOK!



Official fly-them-yourself book of paper airplanes from SCIENTIFIC AMERICAN'S "1st International Competition". Includes plans of all winning entries, time-aloft records, photos, technical data, commentaries. Has 20 unusual designs on perforated pages for easy tear-out. You won't believe how some of them fly! Amusing, entertaining. 128 pages, 9" x 11¾".

Stock No. 9391E .... $2.95 Ppd.

"STICK-PAPER AIRPLANES" BOOK Stock No. 9427E .... $4.95 Ppd.

ORDER TODAY! COMPLETE AND MAIL

EDMUND SCIENTIFIC CO.
300 Edscorp Building, Barrington, N.J. 08007

How Many	Stock No.	Description	Price Each	Total

PLEASE SEND ☐ **GIANT FREE CATALOG "E"** MERCHANDISE TOTAL $

ADD HANDLING CHARGE: $1.00 ON ORDERS UNDER $5.00; 50¢ ON ORDERS OVER $5.00

TOTAL $

30 DAY MONEY-BACK GUARANTEE
YOU MUST BE SATISFIED OR RETURN ANY PURCHASE IN 30 DAYS FOR FULL REFUND

NAME ____________

ADDRESS ____________

CITY ____________ STATE ________ ZIP ________

I enclose ☐ check
☐ money order for $________

MAIL COUPON FOR GIANT FREE CATALOG!

180 PAGES • MORE THAN 4,500 UNUSUAL BARGAINS

Completely new '74 Catalog. Packed with huge selection of telescopes, microscopes, binoculars, magnets, magnifiers, prisms, photo components, ecology and Unique Lighting items, parts, kits, accesories — many hard-to-get surplus bargains. 100's of charts, illustrations. For hobbyists, experimenters, schools, industry.

EDMUND SCIENTIFIC CO.
300 Edscorp Building, Barrington, N. J. 08007
Please rush Free Giant Catalog "E"

Name____________

Address____________

City____________State________Zip________

Bean's Outdoor Sporting Specialties

L.L. Bean, Inc.
Spring 1974

FREE Spring Catalog

Just off the press, our new Spring Catalog. 120 fully illustrated pages of fishing and camping equipment. Outdoor apparel and footwear for men and women. Includes many items of our own manufacture.

Our 62nd year of providing dependable, high grade sporting and outdoor specialties. All fully guaranteed.

☐ Send Free Catalog.

Name ______________________
Address ______________________
____
Zip ______________________

L.L. BEAN INC.
619 Main Street, Freeport, Maine 04032

SECRETS!

GRAHAM HUNTER
?
?

Trapping secrets, that is! Lots of 'em! . . . They're in that fascinating, unusual book—the HAVAHART Trapping Guide. All about animals and things animals do. It tells how to trap 'em *humanely*, too . . . Price list for traps, cages 'n everything is included . . . This great book is FREE and we'd like *you* to get your copy at once. Write for it *today*. Address—

HAVAHART, 158 Water St., Ossining, N.Y. 10562

Please send free trapping guide and price list.

Name______________________
Address______________________
City__________State__________Zip__________

Send 50¢ for Illustrated Catalog
SHELLS, MINERALS, FOSSILS, INDIAN ARTIFACTS
DOVER SCIENTIFIC
Box 6011C Long Island City, N.Y. 11106

Greenhouse gardening is a hobby that will really grow on you!
Write for our catalog.
TURNER GREENHOUSES
Mt. Olive Highway, Goldsboro, N. C. 27530

BOOK HUNTING?
Virtually any book located—no matter how old or long out-of-print. Fiction, nonfiction. All authors, subjects. Name the book—we'll find it! (Title alone is sufficient.) Inquire, please. Write: Dept. 65.
BOOKS-ON-FILE
UNION CITY, NEW JERSEY 07087

Announcements

Geologic Safari

Two geologic field study groups led by Museum geologist Christopher J. Schuberth will tour sites in Kenya and Tanzania this summer. Participants will have the opportunity to collect exceptional mineral and fossil specimens. For information, write to "Museum Tours" here or telephone (212) 873-7507.

Museum Highlights

. . . At The American Museum of Natural History, the February Exhibit of the Month, "The Life of a Vacant Lot," is a reminder that natural phenomena exist—and persist—in an urban setting. This exhibit will be featured in the new Natural Science Center when it opens in April. Each exhibit at the Center will focus on a particular aspect of natural life in the city, and the staff of the Center will be on hand to answer questions and provide additional information.

. . . "America and Other Primitive Cultures," a five-part lecture series beginning February 13. Dr. Malcolm Arth of The American Museum will examine American culture—what we do and why we do it—from the anthropologist's point of view. This is one of several evening lecture programs for adults this spring. For further information, telephone the Museum's Department of Education at (212) 873-7507.

. . . Under the auspices of the Museum's Department of Education, Arthur Mitchell's celebrated Dance Theatre of Harlem Junior Company will give a special performance of classical ballet and modern dance in the Museum auditorium on Sunday, February 17, at 2:00 P.M.

. . . A film on *The Mystery of Animal Behavior* will be shown on Saturday, February 2. This study of life patterns in the animal world by zoologist-photographer Heinz Sielmann is part of the Museum's regular Wednesday/Saturday film program. The screenings, which start at 2:00 P.M., are free of charge to Museum visitors. Please contact the Department of Education for a complete spring schedule.

. . . Selected entries from the journals of Ernest Thompson Seton, world-famed naturalist, are currently on display in the exhibit area adjacent to the Museum library's Rare Book Room, which houses a valuable collection for the use of scientists and researchers.

Photograph Want List

The Want List in the December, 1973, *Natural History* produced several of the photographs in this issue. Readers are invited to submit for possible publication up to ten high-quality photographs on the following subjects: Egyptian temples; nomads, townspeople, and landscapes in the Makran region of Pakistani Baluchistan; wolves on Isle Royale; examples of aggression in any species of primate in its natural setting; the Pine Barrens tree frog; the bog turtle; the great tussock moth; and birds nesting in gutters, eaves, and other parts of recently constructed housing. Pictures that are used will be paid for at the magazine's usual professional rates. Pictures should be sharp, properly exposed color transparencies, 35 mm. or larger. Those that are not suitable will be returned promptly.

Mail transparencies to:
Photograph Editor
Natural History Magazine
Central Park West at 79th Street
New York, N.Y. 10024

Notice: The sending of film to us will constitute an agreement by you that if any such film is damaged or lost by us it will be replaced with an equivalent amount of unexposed film. Except for such replacement, the handling of such film by us is without liability.

A world tour for a fraction of the price

L.A. MUSIC CENTER
PALM SPRINGS AERIAL TRAM
HORSE RACING
LITTLE TOKYO
TIJUANA DOG RACING
QUEEN MARY
LAKE & RIVER FISHING
DESERT DUNEBUGGYING
400 GOLF COURSES
tonight show
WAX MUSEUMS
HOLLYWOOD
BUSCH GARDENS
NBC STUDIOS
DANISH SOLVANG
SHOPPING
L.A. DODGERS
MOVIEWORLD
SHAMU FOR
L.A. ZOO
KNOTT'S BERRY FARM
SEA WORLD
OCEAN FUN
DISNEYLAND

All the things you want to see and do on a perfect vacation are here in Southern California—within easy reach.

You can splash in the ocean—dunebuggy over the desert—bask on the seashore—hike the mountains—all on the same day.

There are more exciting attractions to enjoy than any other place on earth. Rates are unbelievably low—far less than overseas. Everywhere there is endless sunshine to make every day of your vacation count. Take a world tour for a fraction of the price. Come to Southern California.

SOUTHERN CALIFORNIA VISITORS COUNCIL

WRITE FOR YOUR FREE VACATION KIT:
ROOM 150 705 WEST 7TH STREET,
LOS ANGELES, CA 90017. OR SEE YOUR TRAVEL AGENT.

SMIRNOFF SILVER
Ste Pierre Smirnoff Fls
PURVEYORS TO THE IMPERIAL RUSSIAN COURT
1877
1886
90.4 PROOF

SMIRNOFF SILVER® VODKA. 90.4 PROOF. DIST. FROM GRAIN. STE. PIERRE SMIRNOFF FLS. (DIV. OF HEUBLEIN.) ©1973, HEUBLEIN, INC., HARTFORD, CONN

The Silver Martini.
For people who want a silver lining without the cloud.

Smirnoff Silver. Ninety point four proof. Smirnoff leaves you breathless®

NATURAL HISTORY

MARCH 1974 • $1

1974 Imperial LeBaron.
Compare the luxury. Let your comfort be your guide.

CHRYSLER
MOTORS CORPORATION

Optional leather interior does not display standard safety belts.

Come. Sit. An extraordinarily pleasurable experience in automotive comfort awaits your approval.

This is the altogether new Imperial LeBaron.

Look around you. Touch things. Feel the smooth, warm, incredibly plush pillowed velour seat. Or the soft, sumptuous pillowed leather also available. Leather with the suppleness of fine gloves.

Everywhere you look, the attention to detail is apparent. The design, luxurious, but always tasteful. Because we believe the inside of a luxury automobile says as much about its owner as the outside.

Beyond LeBaron's extraordinary physical comforts, there's comfort one takes in power disc brakes at all four wheels—never before available on American luxury cars.

There's the assurance of Chrysler Corporation's Electronic Ignition System that virtually eliminates ignition tune-ups.

The steel-belted radial tires, standard.

And the surprising fact that the engine, equal to the automobile it powers, is powered by regular fuel.

Finally, it should be comforting to know that each and every LeBaron does not leave our care until it has been put through a singularly rigorous test drive, singularly.

May the next test be yours.

CHRYSLER
Plymouth

Imperial LeBaron by Chrysler.
Extra care in engineering . . . it makes a difference.

NATURAL
HISTORY

The determined traveler

There are two kinds of travelers in this world -- the casual ones, and the determined ones.

And 1974 may be the kind of year that separates one from the other.

Today we're hearing about the continued low value of the dollar abroad. The uncertain economic outlook at home.

And the energy shortage everywhere.

It's enough to discourage many casual travelers -- people who are just looking for a little vacation fun. This year, a lot of them may be scared into staying home or spending a week at the beach.

But nothing stops the determined traveler. To him, travel is a basic part of living. His urge to travel is so strong, it takes more than a few little inconveniences to keep him home.

The determined traveler generally has a good reason for traveling. He may be on his way to England to visit her great theaters. Or to France for a wine country tour. Perhaps to Mexico to view ancient civilization. Or to Africa to photograph the wildlife.

Wherever he's going, he's planned his trip carefully -- and he means to take it, come what may.

The determined traveler is often well educated and earns a good income. But he's also uncommonly inquisitive about the world...anxious to keep on expanding his own personal horizons.

Lars-Eric Lindblad, president of Lindblad Travel, has described him this way:

> "He's a curious person; and when I say curious it's in the best sense of that word. A person who is interested. You know, you have too many people in the world who are not interested in anything."

(Turn page, please)

Mr. Lindblad was talking about the readers of Natural History.

On paper, the travel activity of our readers is hard to tell from that of the readers of other highly selective magazines -- which means it's quite good indeed.

But I believe more of our travelers are the determined kind -- readers whose broad interests suggest many imperative reasons to travel often.

Advertisers know Natural History as a productive travel medium. But most of them think of us for their unusual tours, or off-beat destinations.

When it comes to their bread-and-butter advertising -- mass flights or popular places -- they have a way of going to higher-circulation magazines with somewhat lower CPM's.

Well, this year there's a new kind of CPM. CPMDT. Cost per thousand determined travelers.

And nobody beats us there.

Rick Douglas, advertising manager of BOAC, recently told us:

> "We use Natural History because it reaches a group with the kind of psychographics BOAC needs. Income is one thing -- but life style is another."

That life style will keep Natural History readers traveling this year -- no matter what. And you can get to them with a full-color page in every issue -- just to give an example -- for less than the cost of a single page in Time.

Yes, 1974 is shaping up as a challenging year for the travel industry.

We didn't want it.

But we can sure help you get through it.

Cordially,

Harvey Oshinsky

Harvey Oshinsky
Advertising Director

NATURAL HISTORY

Incorporating Nature Magazine
Vol. LXXXIII, No. 3
March 1974

The American Museum of Natural History
Gardner D. Stout, President
Thomas D. Nicholson, Director

2 Authors

4 Letters

8 This View of Life: The Race Problem
Stephen Jay Gould
The computer is not a bigot.

18 Bios: The Unscientific Method
Arthur W. Galston
When you ignore the rules of science, almost anything can happen—including a best-selling book.

26 Flashing Sea Pansies and Glowing Midshipmen
Milton J. Cormier
Medical researchers and even Con Ed can learn something from the cold light processes of primitive creatures.

34 Quail Music
Paul A. Johnsgard
A bird's vocal repertoire is related to its habitat.

41 A Global Imperative for the Environment
Maurice F. Strong　*Drawings by Edward Koren*
Need we fear for the biosphere?

57 A Sultanate Asunder
George Rentz　*Photographs by Bruno Barbey*
Current events are tearing the ancient veil from a secluded Arab monarchy.

68 Running and Jumping
David P. Willoughby
Comparisons are odious, but interesting.

73 Announcements

74 Celestial Events
Thomas D. Nicholson

76 Sky Reporter: A Funny Thing Happened to Comet Kohoutek
Stephen P. Maran

84 Is Science Really Necessary?
A review by Edward Edelson
"Scientists, being human, would like to have both the money and their virginity . . . ."

96 Additional Reading

Cover: *In traditional Arab style, a young Omani girl adorns her eyes with kohl and wears gold ornaments on her headdress and in the side of her nose. The ocher paste on her face protects it from the desert sun. Photograph by Bruno Barbey, Magnum Photos. Story on page 57.*

Alan Ternes, Editor
Thomas Page, Designer
Board of Editors:
Sally Lindsay, Frederick Hartmann,
Christopher Hallowell, Toni Gerber
Carol Breslin, Book Reviews Editor
Florence G. Edelstein, Copy Chief
Karen Bierstedt, Copy Editor
Angela Soccodato, Art Asst.
Diane Pierson, Editorial Asst.
Lillian Gindea
Joyce E. Klutch

Rosamond W. Dana, Publications Editor

Editorial Advisers:
Dean Amadon, Dorothy E. Bliss,
Mark Chartrand, Niles Eldredge,
Vincent Manson, Margaret Mead,
Thomas D. Nicholson, Gerard Piel,
Richard G. Van Gelder

David D. Ryus, Publisher
L. Thomas Kelly, Business Manager
Ernestine Weindorf, Administrative Asst.

Robert E. Williamson, Production Manager

Ann Brown, Circulation Manager
Joan Mahoney
Harriet Walsh

Harvey Oshinsky, Advertising Sales Manager
Gordon Finley
Harry R. Jeter
Vic Asselin
Eileen O'Keefe, Production
Cynthia Dawson, Asst.

Publication Office: The American Museum of Natural History, Central Park West at 79th Street, New York, N.Y. 10024. Published monthly, October through May; bimonthly June to September. Subscriptions: $8.00 a year. In Canada and all other countries: $10.00 a year. Single copies $1.00. Second-class postage paid at New York, N.Y., and at additional offices. *Copyright © 1974 by The American Museum of Natural History. No part of this periodical may be reproduced without the written consent of* Natural History. *Manuscripts and illustrations submitted to the editorial office will be handled with all possible care, but we cannot assume responsibility for their safety. The opinions expressed by authors are their own and do not necessarily reflect the policy of The American Museum.* Natural History *incorporating* Nature Magazine *is indexed in* Reader's Guide to Periodical Literature.

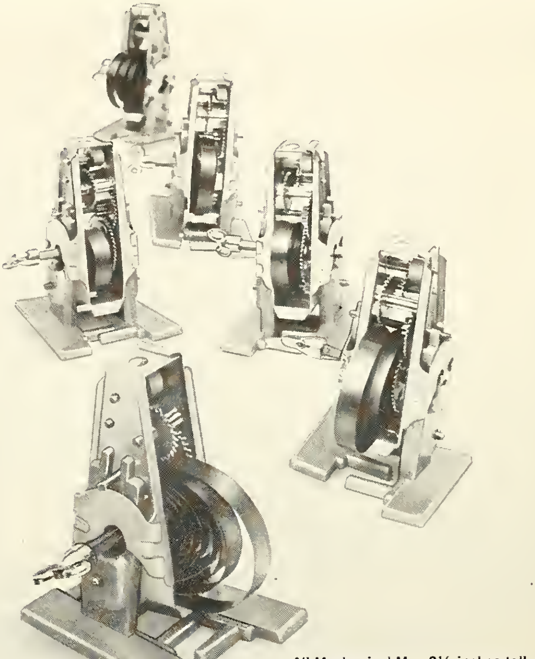
Authors

Curiosity about the mysterious light emanating from some organisms led **Milton J. Cormier**, then a graduate student in biochemistry, to begin his research on bioluminescence more than twenty years ago. Now a research professor at the University of Georgia, Cormier is pleased that "research which stemmed from mere curiosity is now benefiting the medical field" and notes that other scientific discoveries have come about in a similar way. Cormier is now concentrating his research on those marine organisms that possess the most highly evolved forms of bioluminescence in the hope that he can discover how an organism controls its luminosity. Complementing his laboratory research, Cormier spends each summer at the university's marine institute on Sapelo Island off Georgia, where he collects bioluminescent species, walks the deserted beaches, and fishes for bass.

In preparation for his book, *Grouse and Quails of North America* (University of Nebraska Press, 1973), **Paul A. Johnsgard** undertook field work in Mexico and the Midwest where he studied the ecology and behavior of various quail species. His research focused on the role of visual and acoustic communication systems and the evolutionary processes that shaped them. A professor of zoology at the University of Nebraska, Johnsgard has written several articles for *Natural History* based on his ornithological studies. "Natural and Unnatural Selection in a Wild Goose" appeared in the December, 1973, issue.

Retirement has meant more time for **David P. Willoughby** to follow his lifelong avocation, the study of the anatomical dimensions and physical capabilities of animals and human athletes. Formerly a scientific illustrator and research assistant at the California Institute of Technology, Willoughby has compiled a storehouse of information on such animals as apes, elephants, horses, the big cats, and humans. His article on animal ages appeared in the December, 1969, issue of *Natural History*, and he has recently completed a book on the natural history of the horse, *The Empire of Equus*, to be published by A.S. Barnes & Co.

A teacher in Syria from 1932 to 1935, a U.S. government official in Egypt from 1942 to 1945, and an adviser for the Arabian-American Oil Company from 1946 to 1963, George Rentz has worked in Middle Eastern affairs all his professional life. His intensive research into Oman and the Islamic Ibadites began in the late 1940s, when he was studying boundary disputes between Oman and Saudi Arabia. For the past ten years, Rentz, who received his doctorate from the University of California at Berkeley, has been a lecturer in Islamic history at Stanford University and curator of the Middle East collection in the university's Hoover Institution.



The Mechanical Man

A CLASSIC TOY MECHANISM BECOMES A WHIMSICAL LITTLE "MONSTER"

Own a gang of 6 for only $8.95

All Mechanical Men 2½ inches tall

Remember the good old days when they really knew how to make mechanical toys? They made them out of heavy, stamped metal, not plastic. The toys had powerful wind-up motors and lots of whirring, clicking reduction gears that seemed to keep running forever. We used to take the toys apart because the motors were really the most fascinating part.

Well, we discovered a whole warehouseful of top-quality, spring-and-gear mechanisms that were originally meant to power "walking" robots. If these Mechanical Men "monsters" were 6 feet tall, they'd scare the daylights out of you. But at 2½" in height, they're simply captivating. Fascinating beyond belief. They're almost funny-looking . . . almost frightening . . . and completely amusing. They don't just walk. They lumber along . . . with a determination even a Dr. Frankenstein might approve of (and laugh at).

The Mechanical Man is put together with the same precise care Swiss clockmakers use to assemble fine timepieces. The frame (the Man's "body") is made of heavy, cadmium-plated steel. Inside beats a "heart"—a spiral torsion spring—of tough, high-tensile, carbon alloy steel. The wind-up key is built into the body, so it won't get lost.

As the spring unwinds, 9 metal gears (5 of solid brass) go into action. A gear-operated crankshaft rocker mechanism propels the oversize "feet" up and down—and a governor regulates the speed. Just looking at and listening to all the gears turning . . . and seeing how the spring slowly unwinds and expands outward like a puffed belly . . . and watching the big flat feet as they klomp along moving our Man forward like a miniature King Kong . . . is a sight guaranteed to fascinate you! One winding will keep him walking for over 60 seconds (that's a lot of walking) . . . and if he should happen to fall, he'll push himself along, lying "flat on his face."

The Mechanical Man walks on tables, desks, on the floor. Smooth surfaces or rough. Even up a medium size hill. Sometimes he'll go straight. Often he's unruly and will wander all over the place. (You simply can't depend on him for anything—except a good show!) You can race one against another, or all 6 together. You can experiment with "clothing" them to resemble creatures from outer space . . . or earthlings. They'll provide hours of educational fun for the kids. Hobbyists and collectors will find them intriguing. They're absolutely marvelous for relieving executive tensions (some of the more imaginative folk in our office can testify to that). *Order today.* Send check or money order. N.Y. State residents add appropriate tax.

Order No. 45380: Gang of 6 MECHANICAL MEN (complete with built-in wind-up keys) only $8.95 plus $1 postage and handling for each set.

THE *EVERYTHING* GUARANTEE
THE GALLERY guarantees *EVERYTHING:* the quality, accuracy of description, availability, prompt delivery. If not delighted, return the Mechanical Men within 3 weeks after you receive them (not the usual 10 days) for an instant refund of purchase price.

Free Gift Catalog on Request

THE FINER THINGS BY MAIL GALLERY
Dept. 1158, Amsterdam, N.Y. 12010

Letters

Feeding the Children

I found LeRoy Clarke's illustrations for "The Starving Roots of Population Growth" [January, 1974] powerful and moving.

B. Perrin
Burbank, California

Your article "The Starving Roots of Population Growth" pointed out interestingly the unexpected correlation between infant mortality and increased birth-rate. The authors sensibly point out that "the best birth control program is, simply, to feed the children." I wonder, however, if their premise could not be made stronger by emphasizing that human milk must be considered a food—indeed the best food for infants.

Unlike bottle-fed babies, breast-fed babies need not cope with the stress of incompatible or inadequate protein or the ravages of microbial infection from unsterile bottles and poorly refrigerated formulas. Moreover, breast-fed babies receive protection against some diseases from immunity factors in mothers' milk.

Unfortunately, I felt that the authors' neglect of these points, coupled with their specific reference to "maternal deprivation syndrome" as a direct result of breast-feeding, may have led some readers to conclude that lactation and successful breast-feeding are not worthwhile goals.

Susan E. LaGrande
Hyde Park, New York

Dr. Brown Replies:

Ms. LaGrande is correct in pointing out that artificial feeding is causing serious nutritional problems in many developing countries, where infants receive inaccurately prepared, diluted solutions of bacteria-containing formula. In hopes of offsetting the lure of bottle feeding, which is actively promoted by the manufacturers of formula, we are planning to set up programs to promote breast-feeding via active health education and the mass media.

In Praise of Wild Places

I was exceedingly pained and grieved at the arrogance, insensitivity, and supercilious nonsense of the review in your January issue of *The Wild Places: A Photographic Celebration of Unspoiled America.*

The book is a beautiful addition to available materials on wild places. For appreciative eyes, it will incite great delight in places already known, great interest in places not yet seen but cherished in the mind, great joy for all that *lives* and is.

Elva McAllaster
Greenville, Illinois

Energy-Efficient Farming

After reading Eric Hirst's article, "Living off the Fuels of the Land" in the December, 1973, *Natural History*, I thought you might be interested in a Connecticut Agricultural Experiment Station bulletin, "Comparative Efficiency of Energy Use in Crop Production," which I recently completed on the use of energy in farming.

While Hirst remarks in his general analysis that "American farms consume more than one calorie of fuel per calorie of food grown," I have found that farming systems differ markedly in their efficiency of using energy. Although some cropping systems consume about a calorie of energy for each calorie of food energy harvested, others return two to five times the energy investment. Thus, we might increase energy efficiency by growing some crops rather than others, in addition to the economies in retailing and food preparation that Hirst suggests.

Gary H. Heichel
New Haven, Connecticut

Size and Shape

Stephen Jay Gould's entertaining piece on size and shape [January, 1974] and the ignorance of the makers of science fiction movies was itself a pretty fair illustration of his statement that "[they] cannot break free from the prejudices of their perceptions." Speaking as the producer of one of his horrid examples *(Fantastic Voyage)*, I suggest that when Gould says "the creators . . . seem to have no inkling of the relationship between size and shape," he is voicing a prejudice derived from his perceptions of movies and their makers.

Within the limits of our judgment as to what would be convincing and exciting in a movie made to entertain and stimulate, we decided what to show and how to show it. Movies—especially science fiction movies—must deal with the perceptions of a mass audience. If that mass audience accepts the whole idea of shrinking a human being to microscopic size, it would be risky to the suspension of disbelief to include three minutes of dialogue or subtitles explaining surface tension.

Saul David
Culver City, California

After having read Mr. Gould's fascinating discussion, "Size and Shape," I should like to make a statement about his assertion that the kinetic energy of an organism increases as the fifth power of its

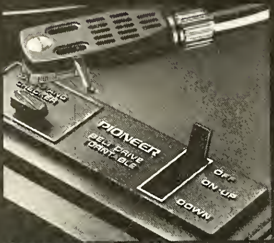
Every Pioneer turntable offers an exceptionally high degree of precision. Our PL-12D does it for $99.95

Despite its simplified operation (only two controls), this versatile performer incorporates a high degree of sophistication. No other turntable in its price range has all of its features: 4-pole, belt-driven synchronous motor . . . static-balanced S-shaped tonearm . . . ultra-light tracking . . . oil damped cueing control . . . 12-inch dynamically balanced die-cast platter . . . anti-skating control . . . foil lined walnut base . . . hinged dust cover . . . 33⅓ & 45 rpm speeds, and much more.

Hear the top performing PL-12D at your Pioneer dealer. Discover how highly satisfying a low price can be.

U.S. Pioneer Electronics Corp.,
75 Oxford Drive, Moonachie,
New Jersey 07074
West: 13300 S. Estrella, Los Angeles
90248 / Midwest: 1500 Greenleaf,
Elk Grove Village, Ill. 60007
Canada: S. H. Parker Co.

Ω PIONEER
when you want something better



Gentle 2-way oil damped cueing control

Anti-skating control minimizes distortion

South America Cruises

Uncrowded luxury, Incomparable cuisine, Warm, personal service...

These are the Prudential-Grace Lines cruises, luxurious cruises to a world as richly varied as any you might imagine. Come join us for a South America adventure. Aboard ship: a fun-filled atmosphere as relaxed and uncrowded as a private resort. Ashore: fascinating places where your dollar is not devalued... the Panama Canal, Cartagena, Caracas, Puerto Cabello, Dutch Curaçao, Rio, São Paulo, Paranagua, Buenos Aires, the spectacular Straits of Magellan, Valparaiso, Lima, and Acapulco. An exciting adventure! Sailings are every 3 weeks on our American ships. The full cruise is 51 days round trip from the West Coast. And numerous sea/air combinations are available. For details, mail coupon or call your travel agent.

Prudential-Grace Lines

Santa Maria • Santa Mariana • Santa Mercedes

Prudential-Grace Lines
One California Street
San Francisco, CA 94106
Call Collect: (415) 781-3800

Send brochure on South America Cruises.
I am also interested in cruises to:
☐ Mexico ☐ Canada

Name
Address
City
State Zip
My Travel Agent Is

Ships of U.S. Registry

length. It would seem to me that he is in error in not allowing for the relationship between time and distance (or length). I believe that kinetic energy developed in an organism varies as the fourth, not the fifth, power of its linear dimensions. This would mean that a child would fall, hit, or dig about 1/16 as hard as a man twice its stature, instead of only 1/32. This, of course, does not detract from the impressive implications of the delightful article.

Junius Wall
Chattanooga, Tennessee

There appears to be one error in Mr. Gould's interesting article "Size and Shape" in the January issue of *Natural History*. The statement "Kinetic energy, for instance, increases as length raised to the fifth power" implies that velocity is proportional to length. This isn't true in either of the examples, and in fact, it is hard to think of a natural example to which it would apply. (A model might be created by conditioning caterpillars of various lengths to avoid a delayed shock by crawling swiftly enough off the electrodes.)

The law of conservation of energy permits one to choose whatever form most conveniently describes a particular problem. The "potential" energy supplied by a falling man or child is simply his weight times the height of fall. For the geometrically similar six-foot man and three-foot child, the weights are in the ratio of eight to one and heights two to one; hence the energy ratio is sixteen to one. Of course, once the subject has landed, the science of terminal ballistics takes over: the volumes of heads absorbing this energy are, for example, in the ratio of eight to one.

In the second example the most convenient measure may be muscular energy. A cubic inch of muscle, acting through one cycle, tends to put out a more or less fixed amount of energy. The man might thus be expected to be able to deal a blow with only eight times the energy available to the geometrically similar child, although he might do somewhat better, one reason being that his greater height demands that a greater proportion of his body weight be muscle.

David B. Hall
Baldwin, Maryland

The Author Replies:

Several readers have challenged my assertion that kinetic energy scales to the fifth power. Indeed it does, but only in special circumstances (as in the examples I cited). Indeed, also, my statement was sufficiently ambiguous to merit the criticism it received. In my example of a man and child falling "unsupported" to the ground, I had in mind the "stiff rod" situation of a person standing upright and falling like a rigid stick (hence unsupported in that nothing breaks the fall), not the "guillotine" situation of heads falling from an equal height. The formula is:

$$\text{kinetic energy} = \tfrac{1}{2} \cdot mv^2.$$

Mass scales as length to the third power; hence, if velocity scales as length, then, where L is length, kinetic energy will scale as L^3 times L^2, or L^5 as I asserted. In stiff rod situations, velocity does scale as length. The entire rod hits the ground at the same time, and points farther and farther from the end originally touching the ground must travel faster and faster in order to reach the ground at the same time, for:

$$\text{velocity} = \text{length}/\text{time},$$

and if time is constant, then velocity is proportional to length. A child is protected by its small size.

Curious Habits

Back in your December, 1972, and February, 1973, issues and growing out of Marvin Harris's ideas about the "unclean" pig, was some discussion of how pigs can acquire the habit of eating human feces.

Recently in a zoo in Frankfurt we were surprised to see a big bull African elephant, after defecating, turn immediately and eat its *own* feces. This was done twice and struck us not only as "unclean," but as highly curious.

Can some writer or reader of *Natural History* enlighten us about this behavior? Is it usual among elephants? Is it known in any other species? Does it have a nutritional or other biological value or is it an aberration arising from confinement? Can the fact that it was a cold winter day have anything to do with it?

De gustibus non disputandum?

Alex J. Pollock
Fischbach im Taunus, West Germany

Bonsai...

Bonsai is the exquisite Oriental art of dwarfing trees.

A Bonsai is a true work of art, a fully matured, living miniature tree that has been painstakingly cultivated for years—some, in fact, for centuries.

Japanese Elm

• 20 years old	$ 34.50
• 30 years old	52.00
• 50 years old	86.00
• 65 years old	115.00

6-pc. Deluxe Bonsai Kit
The complete tool assortment for the serious bonsai lover. Includes shears, pinset, grafting knife, twig nipper, wire nipper and trimming saw in their own zippered pouch. Imported from Japan. By Narishige. $35.00

5-pc. Bonsai Kit Includes shears, cultivator, trimming saw, trowel, pinset. From Japan. $19.95

Bonsai Turntable
Crafted from solid wood with a richly polished wood veneer. Ball bearing swivel. Two handy storage drawers and auxiliary shelf. An ideal work surface and perfect to show off your bonsai to its best advantage! Approx. 11½″ by 11″ dia. $56.00

Blue Moss Cyprus

• 20 years old	$40.00
• 35 years old	69.00

Japanese Cedar

• 20 years old	$40.00

Japanese Juniper

• 15 years old	$34.50
• 25 years old	57.50

Heirob Bonsai Nursery N H 3
Willowemoc Rd.
Livingston Manor, N.Y. 12758
Phone Orders Accepted (914) 439-5706

1. ________________ (age)
2. ________________
3. ________________
4. ________________
5. ________________

Attach inscription if gift card is to be included

☐ Check Enclosed for $______Plus Tax
☐ American Express ☐ BankAmericard
☐ Carte Blanche ☐ Diners Club
☐ Master Charge

Acct. # Expiration date
Name
Address
City State Zip
Signature
Phone

Your Bonsai will reflect the passing years in the character of its trunk and foliage, it will bloom in spring, fruit in summer, even change color with the passing into fall.

Japanese Pine

• 25 years old	$ 46.00
• 30 years old	57.50
• 40 years old	75.00
• 65 years old	143.00
• 90 years old	220.00
• 125 years old	330.00

Books of Bonsai

1. **Practical Bonsai for Beginners** by Murata is the standard primer for the bonsai enthusiast. $7.00
2. **Art of Dwarfing Trees** by Pipe. Deals with U.S. sources for plant materials, fertilizer, accessories. The American slant of bonsai. 8.00
3. **Introductory Bonsai** by Kawasumi is the step-by-step instruction book of bonsai. Profusely illustrated. . 7.00
4. **Bonsai, Bonkei & Saikei**. 9.00
5. **Bonsai**. 7.00
6. **Miniature Potted Trees**. 7.00
7. **Bonsai for Beginners**. 6.00

All Prices Include Insured Delivery

HEIROB
BONSAI
NURSERY

The Race Problem

". . . the pleasures of classifying man fall away, perhaps forever"

Taxonomy is the study of classification, especially the classification of plants and animals. We humans follow rigorous rules of taxonomy for other forms of life, but when we get to the species we should know best, we have particular problems.

We commonly classify modern man into races. Yet under the rules of taxonomy, a species, including *Homo sapiens,* can only have one formal subdivision: the subspecies. So races, if used taxonomically, have the status of subspecies.

Quantitative techniques introduced in taxonomy during the past decade have suggested different methods for studying geographic variability within species, and many scientists have gradually abandoned the practice of dividing species into subspecies. While the designation of human races cannot be divorced from social and ethical questions, these new taxonomic procedures add a new biological argument to an old debate.

I contend that continued racial classifications of *Homo sapiens* represent an outmoded approach to the general problem of differentiation within a species. In other words, I reject a racial classification of human beings for the same reasons that I prefer not to divide into subspecies the prodigiously variable West Indian land snails that are the subject matter of my own research.

The argument against racial classification has been made many times before, most notably by eleven authors in *The Concept of Race,* a book edited by Ashley Montagu in 1964 (republished in 1969 as a Collier-Macmillan paperback). Yet these views did not command general assent because taxonomic practice a decade ago still supported the routine designation of subspecies. For example, in a 1962 publication Theodosius Dobzhansky expressed astonishment that "some authors have talked themselves into denying that the human species has any races at all! . . . Just as zoologists observe a great diversity of animals, anthropologists are confronted with a diversity of human beings. . . . Race is the subject of scientific study and analysis simply because it is a fact of nature." And Grant Bogue, in a debate with Ashley Montagu, recently wrote: "Some misfit academicians have said no, that this is all a mistake . . . and some have gone so far as to suggest that even the very concept of race is all in our heads. . . . To this contention there are several answers. One is often voiced: race is self-evident."

There is a glaring fallacy in these arguments. Geographic variability, not race, is self-evident. No one can deny that *Homo sapiens* is a strongly differentiated species; few will quarrel with the observation that differences in skin color are the most striking outward sign of this variability. But the fact of variability does not require the designation of races. There are better ways of studying human differences.

The category of species has a special status in the taxonomic hierarchy. Under tenets of the "biological species concept," each species represents a "real" unit in nature. Its definition reflects this status: "a population of actually or potentially interbreeding organisms sharing a common gene pool." Above the species level, we encounter a certain arbitrariness. One man's genus may be another man's family. Nonetheless, there are certain rules that must be followed in the construction of hierarchies. You cannot, for example, place two members of the same taxon (genus, for example) into different taxa of a still higher category (family or order, for example).

Below the species level, we have only the subspecies. In *Systematics and the Origin of Species* (Columbia University Press, 1942), Ernst Mayr defined this category: "The subspecies, or geographic race, is a geographically localized subdivision of the species, which differs genetically and taxonomically from other subdivisions of the species." There are two criteria: (1) A subspecies must be recognizable by features of its morphology, physiology, or behavior, that is, it must be "taxonomically" (and by inference, genetically) different from other subspecies; and (2) A subspecies must occupy a subdivision of the total geographic range of the species. When we decide to characterize variation within a species by establishing subspecies, we partition a spectrum of variation into discrete packages with distinct geographic borders and recognizable traits.

The subspecies differs from all other taxonomic categories in two fundamental ways: (1) Its boundaries can never be fixed and definite because, by definition, a member of one subspecies can interbreed with members of any other subspecies in its species (a group that cannot breed with other closely related forms must be designated as a full species); (2) The category need not be used. All organisms must belong to a species, each species must belong to a genus, each genus to a

Detach
this card
and mail for

Free
COLOR PROSPECTUS

with illustrations from the
Encyclopedia of World Art
and full details of the
advantageous budget
plan for Subscribers.
No stamp required.

FIRST CLASS
PERMIT NO. 26
NEW YORK, N.Y.

BUSINESS REPLY MAIL
No Postage Stamp Required if Mailed in the U.S.

Postage will be paid by

Encyclopedia of World Art

McGraw-Hill Book Company
1221 Avenue of the Americas
New York, N.Y. 10020

WHATEVER MAN HAS
CREATED THAT IS
BEAUTIFUL TO LOOK
UPON NOW AWAITS
YOUR DISCOVERY IN
THIS EXTRAORDINARY
SET OF BOOKS

Mail card for free Prospectus

Encyclopedia of World Art

McGraw-Hill Book Co., 1221 Avenue of the Americas, New York, N.Y. 10020

Please send me your 20-page illustrated full-color prospectus which gives complete details about the 15-volume Encyclopedia of World Art and budget terms for subscribers. There is no obligation, of course. No salesman will call.

Name ____________________

Address ____________________

City ____________________

State ________________ Zone or Zip No. ________

This offer applies to U.S. and Canada only. AY-129

Free *to readers with an abiding joy in the arts*

The most eminent art authorities of today are your guides to the world of art and the artist

The story of a "monument to man's visual imagination"

—SATURDAY REVIEW

IF YOUR PLEASURE in art is deep and wide-ranging, we invite you to send for this handsome booklet.

It is illustrated with beautiful color plates representing man's creative triumphs from many periods and cultures.

It is in fact a prospectus describing in detail the most extraordinary publishing project of our time—the monumental Encyclopedia of World Art in 15 volumes.

The prospectus is free. We hope the sampling will arouse the same excitement in you that the Encyclopedia has aroused in the entire art world. But you incur no obligation in requesting a copy. No salesman will call.

The Encyclopedia of World Art embraces man's greatest achievements in the visual arts through the centuries. To turn the pages of these prodigious volumes . . . to read, to learn, to explore their visual delights . . . is a remarkable experience.

There are hundreds of absorbing factual articles, prepared by the most eminent art authorities. In more than 7,000 superb full-page plates—measuring a full 9 inches by 12 inches in size—you will view rare treasures of renowned museums and private collections all over the world. Not only paintings, sculpture and architecture—but every art from armor to textiles, ceramics to tapestry, fashions, furniture and landscape gardening, ivory, jade and stained glass, jewelry and silver. More than 16,000 works of art are shown, almost 2,000 of them in magnificent color.

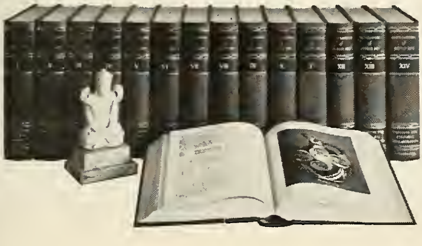
A convenient Reader's Guide shows you how related articles can enrich your understanding of any art subject you wish to pursue.

With your free color prospectus, you will learn how you may examine Volume I at leisure in your home and, if you wish, become a subscriber to the Encyclopedia on a convenient budget plan. Mail the attached card or write:

McGraw-Hill Book Company, Dept. AY-129
1221 Avenue of the Americas, New York, N. Y. 10020

Encyclopedia of World Art

Whatever man has created that is beautiful to look upon . . . in a 15-volume art library and "gallery" for the home



"An essential possession for anyone with a serious personal or professional interest in art . . . a work to be explored, studied and enjoyed."
Harry Einbinder, *The Saturday Review*

"A great landmark in art publications—a monumental undertaking."
Dorothy Adlow, *Christian Science Monitor*

"Packed with wonders." John Canaday, *New York Times*

"One of the most spectacular—and praiseworthy—achievements in the field of literature and fine arts." Rex Barley, *Los Angeles Mirror News*

MAIL THE ATTACHED CARD

Freedom in a bag
for as little as $29.95!

Pyrawa Sport Canoes and our NEW
Sea Eagle Cruising Canoes & Dinghies!

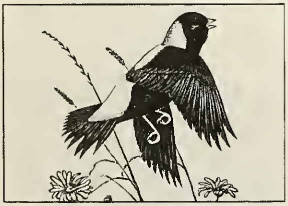
Quality inflatables that last!

Whitewater rivers, ocean surf, remote lakes and streams . . . discover the waterways of America! Canoes from $69.95 to $142.95. Dinghies from $29.95 to $99.95. Send now for our free color brochure!

Leisure Imports, Inc. Dept. NH 3-74
St. James, New York 11780 (516) 724-8900

THE DROLL YANKEES

PHONORECORDS listed below are
12″ 33 RPM, $6 ea., 3 for $15,
all 7 for $32 postpaid



☐ **BIRDS ON A MAY MORNING** 36 American songbirds. A subdued running commentary identifies each songster.

☐ **THE FROG POND** Life in a pond filled with the voices of many amphibians. Sounds alone on one side — sounds identified on the other.

☐ **THE SEA AT CASTLE HILL** Screaming gulls and a pounding surf on rocky headland. On the flipside, a sideweeler voyages up the Hudson.

☐ **THE FARM** Features all the farmyard animals in the harmonious world of a Vermont family farm.

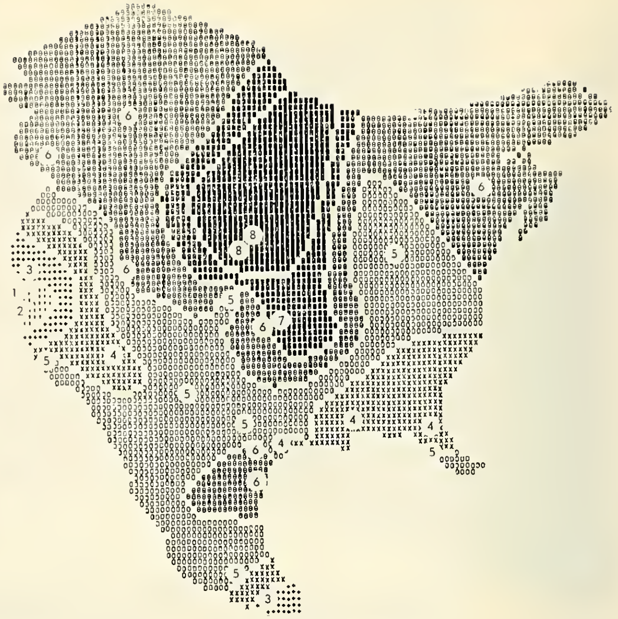
☐ **THE SWAMP IN JUNE** Beavers splashing, green frogs plunking, birds singing. Sounds with commentary on the flip side.

☐ **SONGS OF THE FOREST** Recorded in a deep wood ringing with the calls of many woodland birds. Flip side with commentary.

☐ **THE EDGE OF THE MEADOW** James Baird and Peter Kilham on a bird walk. 17 American birds of field, forest and wetlands. On side 2, bird songs alone.

Write for circular describing Droll Yankees 12″ and 7″ records and their bird feeders.

DROLL YANKEES INC
Box 229 H, Barrington, R. I. 02806



A map generated and drawn by a computer shows the distribution by size of male house sparrows in North America. The higher numbers indicate larger sizes, based on a composite of sixteen different measurements of the birds' skeletons.

family, and so on. But there is no requirement that a species be divided into subspecies.

Actually, *the subspecies is only a category of convenience.* We use it when we judge that the understanding of variability is best served by establishing discrete, geographically bounded packages within a species. Many biologists are now arguing that the subspecies concept applied to such dynamic patterns of variability is not only inconvenient but downright misleading.

How can we deal with the rich geographic variability that characterizes so many species, including our own? One example of the old approach is a monograph published in 1942 on geographic variation in the Hawaiian tree snail *Achatinella apexfulva.* The author divided this astonishingly variable species into seventy-eight formal subspecies and sixty additional "microgeographic races" (for units a bit too indistinct for subspecific status). Each subdivision received a name and a formal description. The result is a voluminous and almost unreadable tome that buries one of the most interesting phenomena of evolutionary biology under an impenetrable thicket of names and static descriptions.

And yet there are patterns of variation within this species that would fascinate any biologist: correlations of shell form with altitude and rainfall, variation subtly attuned to climatic conditions, routes of migration reflected in the distribution of color markings on the shell. Shall our approach to such variation be that of a cataloger? Shall we artificially partition such a dynamic and continuous pattern into distinct units with formal names? Would it not be better to map this variability objectively without imposing upon it the subjective criteria for formal subdivision that any taxonomist must use in naming subspecies?

I think that most biologists would now answer "yes" to my last question; I think they also would have spoken against the formal taxonomy thirty years ago. Why, then, did they continue to treat geographic variation by establishing subspecies? They did so because objective techniques had not been developed for mapping the continuous variation of a species. They could, to be sure, map the distribution of single characters, for example, body weight. But variation in single traits is a pale shadow of patterns in variation that affect so many features simultaneously. Moreover, the classical problem of "incongruity" arises. Maps constructed for other single traits almost invariably present different distributions: size may be large in cold climates and small in warm, while color is light in open country and dark in forests.

A satisfactory procedure for objective mapping demands that variation in many characters be treated simultaneously. This simultaneous treatment is called "multivariate analysis." Statisticians developed the basic theories of multivariate analysis many years ago, but its routine use was inconceivable before the invention of large electronic computers. The computations involved are extremely laborious and quite beyond the capacities of desk calculators and human patience; but the computer can perform them in seconds.

During the past decade, studies of geographic variation have been transformed by the use of multivariate analysis. Almost all the proponents of multivariate analysis have declined to name subspecies. You cannot map a continuous distribution if all specimens must first be allocated to discrete subdivisions. Is it not better simply to characterize each local sample by its own morphology and to search for interesting regularities in the maps so produced?

The English sparrow, for example, was introduced into North America in the 1850s. Since then it has spread geographically and differentiated morphologically to a remarkable degree. Previously, this variation was treated by naming subspecies. R. F. Johnston and

Just possibly the most useable jacket you can own.

A 10 oz. reversible jacket that's made like a space suit to work like a thermos bottle!

When the guy who makes the Apollo Jacket first showed it to me, he said it would keep me warm in cold weather and comfortably cool when it was warm. I explained to him (using some fairly spicy words) that he should seriously consider committing himself before somebody else did. And it's a good thing I used those "spicy" words, because I ended up eating every one of them.

Four years of testing convinced me!

After 4 years of personal testing in places ranging from a Swiss ski resort to tropical Tenerife in the Canary Islands, I can honestly say that this is one of the most useable jackets available today. It's made from a fabric developed for use in space suits, and it really works.

Here's how!

A tough aluminum skin is bonded to 100% nylon to give you a jacket that reverses to suit the weather and your comfort. Wear the navy side out when it's cold. It absorbs warmth from the sun and the silver side next to your body retains a large percentage of your natural heat. In warm weather, wear the silver side out. It reflects the sun's rays and helps keep you comfortably cool.

Try it yourself for two weeks!

I know this is a tough one to believe, and that's only half of it. The Apollo is also *windproof*, practically *rainproof*, and can be rolled up for carrying in your back pocket. Try it yourself for two weeks. If you're not completely satisfied, return it to us, postage prepaid, for a full refund. No ifs, ands, or buts.

Color: Blue reversing to silver. **Sizes:** S, M, L, XL, XXL, to fit Men's 34-52; Women's 6-20. Send suit or dress size for proper fit.

$29.50 ppd.

Rolls up for easy packing.

Tuck-away hood in collar.

Reverses to keep you warm when it's cool and cool when it's hot.

Windproof, practically rainproof, and made to withstand hard use.

Norm Thompson

Dept. NH-M
1805 N.W. Thurman
Portland, Or. 97209

Order toll free anytime (800) 547-6712

Name

Address

City

State Zip

Apollo Jkt.	Qty.	Size
Men's		
Women's		

☐ Check enclosed. Charge to my
☐ BankAmericard ☐ Master Charge.
(Please include all raised letters and numbers on credit card.)

Card #

Signature X

Escape from the ordinary

☐ **Send FREE 80 pg. color catalog**
Just off the press and loaded with new and exciting items, many of which simply can't be purchased anywhere else in the world. Save on exclusive fashions, sports equipment, and articles for your home.

The amazing story

It was made in England in the eighteenth century and it cracked the very first time it was rung on these shores. Yet for soldier and citizen it has remained an enduring symbol of Liberty and Freedom in the new republic. Read on about the Liberty Bell and about a rather shrewd investment some twentieth century Americans are making in it.

In 1751, the Province of Pennsylvania had a policy of individual freedom that much influenced the other colonies. It was fitting that when the Assembly of the Province decided to order a bell, they asked that on the bell's shoulder be inscribed the biblical phrase from Leviticus XXV. 10 "Proclaim liberty throughout all the land unto all the inhabitants thereof." Thomas Lester's Whitechapel Foundry in London was chosen to cast the bell and in September 1752, it arrived in America. Philadelphians gathered in the State House yard to hear it ring out. It cracked, however, upon the first strike, perhaps due to mishandling by amateur colonial bell hangers, eager to hear it. In 400 years, it was to be the only bell from Whitechapel's to have so cracked. "Two ingenious workmen", John Pass and John Stow recast it, but Norris did not like its tone and had it recast a second time. It was then hung in the State House tower; and for the next twenty years, it would ring out on the burning issues of the day. It loudly proclaimed the coronation of George III but was muffled as it sadly tolled the "death of liberty" when the Stamp Act was enforced in 1765.

THE BIRTH OF A NATION

On June 1, 1774, the bell was again muffled and tolled in sympathy with the people of Boston on the closing of their port. Following receipt of tidings of the Battle of Lexington, April 25, 1775, the bell called together 8,000 people (by computation) who assembled in the State House yard and agreed, unanimously, "to associate for the purpose of defending with arms, our lives, liberty and property against all attempts to deprive us of them."

The supreme effort of the bell to proclaim liberty was next in order. The historic second session of the Continental Congress was already underway, and the final break with Great Britain only a matter of weeks, perhaps days. The resolution sponsored by Richard Henry Lee was presented June 7, 1776, declaring "that these United Colonies are, and of right ought to be, free and independent states; that they are absolved from all allegiance to the British Crown and that all political connection between them and the State of Great Britain, is and ought to be totally dissolved;" In the interval, a special committee had been appointed to draft a formal statement. The Lee resolution was agreed to July 2, and the Declaration penned by Thomas Jefferson, after revision in the committee of the whole, adopted July 4. Then, on July 8, 1776, the bell rang to summon the patriots for the first public reading of the Declaration of Independence, which had been adopted four days earlier by the Continental Congress. The bell was now part of American history. The birth of an Independent Republic, the seed of a world power, was an accomplished fact. The old State House Bell, as it was then called, was now to "Proclaim liberty throughout all the land unto all the inhabitants thereof," to ring out independence, to have its sequel taken up in every town and hamlet, to set in motion a never-ceasing force against tyranny and oppression.

Before the advent of the second anniversary of liberty, the bell again added a dramatic chapter to its history. The echoes had not died away when it was realized the British army, under General Howe, was uncomfortably near Philadelphia. With the threat of British occupation of Philadelphia in 1777, the State House Bell, which had now become the Liberty Bell, was removed from the city to prevent it falling into British hands to be made into cannons along with the other city bells.

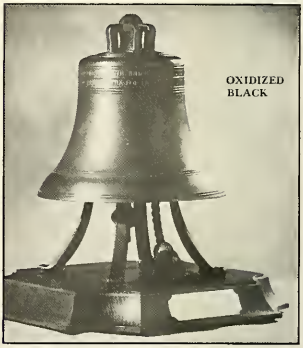
The Liberty Bell, and the ten other bells in the city, were loaded onto wagons which joined a 700 wagon train of refugees fleeing Philadelphia. The tradition has been handed down "that John Jacob Mickley hauled the bell fifty miles away to Bethlehem, where his wagon broke down; whereupon it was transferred to Frederick Leaser's wagon, who brought it on to Allentown." On arrival, the bell was hidden below the floorboards of the Zion Reformed Church for almost a year and returned to Philadelphia in the summer of 1778 when the British withdrew. Since then, it has pealed forth great news. It sang out, loud and clear, from Cornwallis' surrender in 1781, until it cracked permanently in 1835. It has been cautiously rung many times since with a rubber mallet. In 1944, on D-Day, its muffled sound was broadcast over network radio.

IN COMMEMORATION

To commemorate the 200th anniversary of the Declaration of Independence in 1976, the famous Whitechapel Bell Foundry of London (the same bellmakers who cast the original Liberty Bell) is casting a limited number of Bicentennial Liberty Bells to the original design and on the original site. The purchase price of the replica in the oxidized black finish (the same color as the 1752 bell) is $875. In polished bronze it is $925 . . . in .999 Silver plate it is $990 and in 22 karat gold plate it is $1365. These prices include duty, special crating, insurance and overseas shipment to the U.S.A.

The Bicentennial bells are exact in every particular to that cast in 1752 by Whitechapel's master founder, Thomas Lester, for the State House of Pennsylvania (now called Independence Hall). The Whitechapel Bell Foundry was founded in 1570 during the reign of Queen Elizabeth I. Many of its earliest bells are still in existence, including two bells at Westminster Abbey cast in 1583 and 1598. Among the recent bells from Whitechapel are those of Washington Cathedral, hung in 1964. The bells of Big Ben, which towers over the Houses of Parliament, were also cast at Whitechapel, as were the great bell of Bow in London in 1750 and the bells of St. Clement's in 1588, the year of the Spanish Armada. Both are remembered in the old nursery rhyme, "Oranges and Lemons."

Each Liberty Bell replica is made to the scale of one-fifth of the original, weighs approximately twenty pounds and stands 15½ inches high with the base. The plinth is hand-carved from oak, grown in Windsor Forest. A silver plate mounted on the plinth is fashioned from fine old English solid silver and carries the Whitechapel signature. Also, an additional optional silver plaque will carry the personal inscription of the subscriber. The bell itself is made in the manner of the original Liberty Bell, embossed with the quotation from Leviticus XXV. 10 in type face used by the original bellfounder, Thomas Lester. The clapper, drawn into a hand grip with a tasseled cord, strikes the walls of the bell and causes it to ring a perfectly-tuned note at each stoke. Each bell has been meticulously tuned (actually five partial tones are tuned together) to its final and perfect pitch—E Flat—the same tone as the 1752 bell. The bell will have no crack! It will sing its song as magnificently as the original Liberty Bell did when Lester tested it before it left London. In this way, the ancient and historic contract between London and Philadelphia is fulfilled.



OXIDIZED BLACK

HOW TO MAKE A BELL

To make this reproduction possible, the Whitchapel Bell Foundry has incorporated and refined an ancient process which had not been used in bellmaking for over 600 years but has been used mainly to reproduce exact detail in fine metallic art work. This is the cire perdu or "lost wax" method of bellcasting, which was recorded most notably in the 12th century by the medieval monk Theophilus in his "De Diversis Artibus", but which was subsequently superseded by the "false bell" method. The principal advantage of the "lost wax" process—and an absolute essential in the making of the Bicentennial Liberty Bell—is the high quality of the resultant castings, particularly where intricate or decorative work is involved. The Liberty Bell has an inscription of 170 separate letters, and this inscription proved disappointing when cast normally at a scaled-down ratio of five to one. To

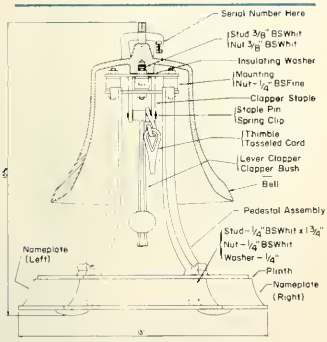
# of the Liberty Bell

overcome this, and to preserve the clarity of the lettering at reduced size, the Whitechapel Bell Foundry evolved, after two years' research, a process which involved fashioning the primary pattern of the bell not in traditional clay but in wax of medieval bellmakers.

In essence, the technique at the primary stages is not dissimilar to that described by Theophilus, although now considerably refined. In short, it involves making a complete bell in wax, and then investing, or coating, this in a ceramic material.

PERFECTION OR DOOM

This ceramic material builds up very slowly in outer shell of some ten coats thickness, using a combination of first aqueous colloidal silica and then calcined china clay. This process, carried out by hand with immense care, is critical to the whole and takes about a week. Any error in the application can result in an imperfection, in which all of their exacting work is for naught, for each finished bell must be *perfect* or it is destroyed and consigned to the kiln.



The invested bell is then placed in a de-waxing furnace, which melts the original pattern, leaving only the ceramic shell—now the master pattern. This is baked at high temperature and provides the final mould from which the actual bell is then cast with molten bell metal. When the metal has cooled and hardened, the ceramic pattern is smashed away, leaving a magnificent bronze bell.

The casting, and all subsequent stages—such as tuning, polishing, and assembly—are done by conventional methods, the result being a bell of the highest authenticity. The process allows the foundry to capture the original lettering of 1752—the precise form of the letters used by Thomas Lester was checked by reference to dozens of bells cast by him and still in use in steeples all over England—while at the same time solving a secondary problem: the general surface finish is of a higher quality than is normally possible with bells of this size. Thus, these Bicentennial Liberty Bells bring together the 14th and the 18th centuries and bridge a gap that has lasted for 600 years.

MOUNTING

The mounting of the Bicentennial Liberty Bell has been carefully engineered and no detail has been spared to obtain absolute perfection. The bell is secured by a single center bolt inside its crown to a steel plate to which the jaws of the clapper staple are welded. The forged clapper swings between these jaws on a plated steel pin running in a nylon sleeve to ensure free silent action and perfect mechanical insulation. It is actuated by a silken tassel attached by a solid brass eyelet to a lever which is part of the clapper forging.

To provide the "give" necessary to insulate the bell and clapper together from the forged pedestal and oak base, and to enable it to absorb the occasional jolt in safety, the steel crown plate is connected to the pedestal through four special neoprene and rubber vibration mountings, which in turn are mounted on a steel ring which forms a common connection for the four "legs" of the pedestal. The lower ends, or feet, of these forgings are bolted through the oak plinth. In reducing a bell by scaling it down to one-fifth of its original size, the clapper must be reduced by the same scale to maintain the correct proportion; but while profiles can be scaled, "nature" cannot and the miniature clapper would not bring out the rich tone of the bell. This problem was overcome by introducing into the striking face of the clapper forging a "plug" made from a special type of nylon, which backed up by the weight of the clapper bell, ensures that the bell gives its full tonal resonance.

MADE TO ENDURE

Theophilus, writing on the intricacies of bell founding, stated "that the craft requires *not* indolent workmen, but keen dedicated men, for fear the bell be spoiled at some point in its manufacture." Whitechapel has ensured that nothing has been spared in the design and making of the Bicentennial Bells and their mountings and has fully maintained the ancient traditions of its craft. These bells have been made to *endure*. With proper care, there is no reason why they should not ring in the tercentary and quadricentary celebrations of these United States. Every bell is fully guaranteed—against any defect. And they are guaranteed *never* to crack!

Only 2,400 bells will be cast—each bell thus symbolically representing a separate month of independence. WHEN THE LIMITED EDITION IS COMPLETED, THE MASTER MOULD WILL BE DESTROYED. Only a limited number of Americans will ever have the privilege of owning one.

A PRUDENT INVESTMENT

Although the bells have been available but a relatively short time, more than 800 have already been snapped up by collectors, businesses, universities, and private individuals. Indeed a bell, purchased from one of the earlier castings, would already bring almost 23 percent more in resale at the established price.

While there are no direct comparisons, it is interesting to chart the continuous growth in value of certain other limited editions during recent years. The Winston Churchill Commemorative Medal struck in London in 1965 increased in value by 80 percent within two years. Perhaps the record is held by a pair of Dorothy Doughty quail, issued by the Worcester Royal Porcelain Company in 1940 as part of a limited edition, which fetched about $50,000 in a spirited auction recently. To take a more ordinary example, a porcelain figure of Princess Elizabeth, part of a 1947 limited edition, sold for $280 each, is now valued at over $4,000.

GOOD TO GET – GOOD TO GIVE

Of the nearly nine hundred bells thus delivered, each has been received with absolute satisfaction. Historical Societies, Foundations, Businesses, Churches, Museums, even Government Agencies, have been, without exception, well pleased. So, too, have the most finicky of private collectors. A number of generous subscribers have ordered the bells for the purpose of donating them to Universities, Colleges, and Museums. Some subscribers order one for themselves (and their families) and another to donate. Such a gift will be long-remembered.

If you wish to order a bell, we urge you to send your deposit at once to avoid disappointment. Since less than 1,500 replicas remain and the total readership of NATURAL HISTORY is estimated to exceed a million people, orders must therefore be honored strictly on the basis of time of receipt, and we cannot guarantee early delivery of any order received after April 15, 1974.

To commission the casting of a bell, simply make your check payable to "Liberty Bell Limited Edition" for $875; or, if you prefer, just send a $100 deposit. Mail your check to LIMITED EDITIONS COLLECTORS SOCIETY, 160 Old Derby Road, Hingham, Mass. 02043, the exclusive representatives for Whitechapel in America. Upon receipt of your order, you will be promptly informed in writing of the reservation of the casting of your bell. Each bell is fully and unconditionally guaranteed. They are not available in stores — nor will orders from stores be accepted.

NH

Liberty Bell
Limited Edition
Limited Editions Collectors Society
160 Old Derby Road, Liberty Plain,
Hingham, Massachusetts 02043 (617) 749-3502

To: Mr. Douglas Hughes, Master Founder
Whitechapel Bell Foundry; London:

I wish to commission the casting of a Liberty Bell Replica. Please make a casting reservation, and assign a serial number to me. I understand that upon completion of my bell I will receive an owner's certificate and will be listed in your master founder's directory as the original owner. The bells in this limited edition are serially numbered in the order in which payment or deposits are received.

SELECT ONE FINISH

OXIDIZED BLACK ☐ 999 SILVER PLATE ☐ POLISHED BRONZE ☐ 22 KARAT GOLD PLATE ☐

Signature

Name (Please Print)

Street

City **State** **Zip**

☐ **Payment in full is enclosed**
☐ **$100 deposit enclosed**
☐ **I desire a special inscribed silver plaque**
☐ **Send brochure ($1 enclosed)**

Cloud-Soft Travelers

Down Sox
For Men
and Women

Tuck these Sox into a travel bag, wear them to bed, enjoy them as slippers or as inner sox for your insulated pacs or waders. Bauer Goose Down is quilted in soft, tough Nylon taffeta. **Colors:** Red, Winter Blue, Taupe, Powder Blue. **Sizes:** Specify men's or women's shoe size and we will supply proper fit. **0123** Sox, pair **$7.95** postpaid.

Order Today! Money Back Guarantee!
Enclosed is my check or money order for
$________. (Add sales tax where applicable.)
Please RUSH my 0123 Goose Down Sox.
Men's Size________Color________________
Women's Size________Color________________
Name________________________________
Address______________________________
City_________________________________
State______________Zip______________
☐ Send me FREE your new color catalog of over 1000 exciting outdoor products.

Eddie Bauer®

Dept. GNH, 1737 Airport Way S., Seattle, Wa. 98124

NATURAL SCIENCE TRIPS for museum associates

- ☐ **Iceland Birding,** with visits to glacial and volcanic phenomena, July 13-27.
- ☐ **St. Elias Glaciology,** hiking to glacier research camp in Canada's Yukon Territory, August 14-28.
- ☐ **Grand Canyon Geology Float Trip,** rafting down Grand Canyon with geologist interpreting exposed stratigraphy, September 7-14
- ☐ **Alaska Eagle Photography,** during bald eagle concentration at Chilkoot River salmon run, September 15-22.
- ☐ **Leakey's East Africa,** visiting dig sites at Lake Rudolf and Olduvai Gorge with Richard and Mary Leakey, plus the best of East Africa's game parks, September 16-October 14.
- ☐ **Huichol, Mexico,** ethnology and folk art of western Mexico's Huichol Indians, October 26-November 15.

For detailed brochures, send to Wilderness Expeditions, Inc., Museum Programs, Route 292, Patterson, New York 12563.

R. K. Selander (in *Science*, 1964, p. 550) refused to follow this procedure. "We are not convinced," they argued, "that nomenclatural stasis is desirable for a patently dynamic system." Instead, they mapped multivariate patterns of variation. One of their maps showed a combination of sixteen morphological characters representing general body size. Variation is continuous and orderly. Large sparrows tend to live in northern, inland areas, while small sparrows inhabit southern and coastal areas. The strong relationship between large size and cold winter climates is obvious. But it would not have been so obvious if variation had been expressed instead by a set of formal Latin names artificially dividing the continuum.

In addition, this pattern of variation reflects the operation of a major principle of animal distribution. Bergmann's rule states that members of a warm-blooded species tend to be larger in cold climates. The standard explanation for this regularity involves the relationship between size and relative surface (discussed in my two previous columns). Large animals have relatively less surface area than smaller ones. Since animals lose heat by radiation through the external surface, a decrease in relative surface area helps the body keep warm.

Of course, patterns of geographic variation are not always so orderly. In many species, certain local populations are quite different from immediately adjacent groups. It is still better to map these patterns objectively than to allocate static names.

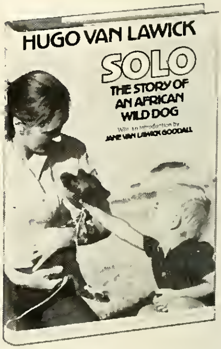
Multivariate analysis is beginning to have a similar effect on studies of human variation. In past decades J. B. Birdsell, for example, wrote several distinguished books that divided mankind into races, following accepted practice at the time. Recently he has applied multivariate analysis to gene frequencies for differences in blood types among Australian Aborigines. He rejects any subdivision into discrete units and writes: "It may well be that the investigation of the nature and intensity of evolutionary forces is the endeavor to be pursued, while the pleasures of classifying man fall away, perhaps forever."

Columnist Stephen Jay Gould teaches geology at Harvard University.

FARLEY MOWAT:
"This is a superb book . . . simple, direct, beautifully written and a vehicle of truth."

SOLO

The true story of an African wild dog puppy
By HUGO VAN LAWICK
With an Introduction by
JANE VAN LAWICK-GOODALL


HUGO VAN LAWICK
SOLO
THE STORY OF AN AFRICAN WILD DOG
With an Introduction by JANE VAN LAWICK GOODALL

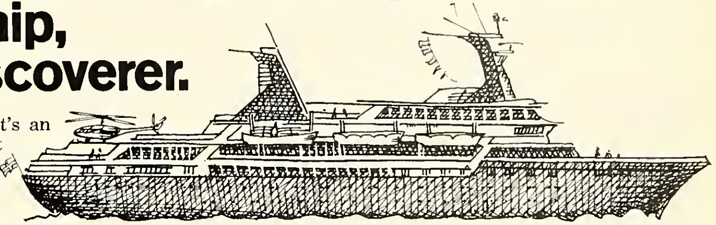
"You don't have to be a naturalist to understand or love a lion cub, a chimpanzee or any of the other animals we have in our wisdom or lack thereof deemed cute. It takes a naturalist, though, to comprehend the meaning and value of a hunting dog. It also takes a writer to make us see his world through the eyes of a skilled naturalist. In SOLO, Hugo van Lawick is the naturalist and writer who succeeds on all fronts. A fresh and important view of wildlife in wild places and the forces that shape and preserve them both." — ROBERT CARAS, author of *Death as a Way of Life*

SOLO is the story that inspired the nationally televised documentary *The Wild Dogs of Africa*, winner of two Emmy Awards.

Illustrated with photographs in full color, line drawings and maps
At your bookstore • $6.95

HOUGHTON MIFFLIN COMPANY
2 Park Street, Boston 02107

Dare a little. Climb into the boots of Leif Ericsson. Look a volcano in the eye. Master the sea. Discover Vinland on the new pleasure expedition ship, M/V Bewa Discoverer.



This is no ordinary cruise. It's an *expedition-cruise,* a vacation concept offered by Thomas Cook for people who have done the usual things and are ready to see something different in a genuinely different way.

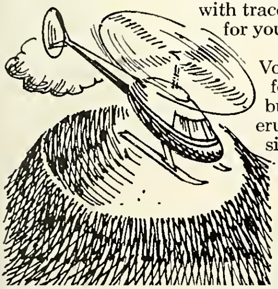
People who really are ready to dare a little.

Well, the places are different: Scara Brae, Helluland and such.

And the different way is the M/V Bewa Discoverer, a ship about as unique in its own way as the Viking vessels were in theirs.

The most unusual itinerary since 900 A.D.

On June 8 your ship leaves Copenhagen. First stop, a visit to Scandinavian museums and the original Viking ships.



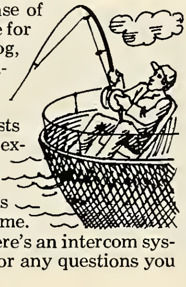
Westward then to Jarlshof, the Orkneys and the Faroes. Among the first islands visited by the Vikings, with traces of their visits still there for you to see.

Now Iceland. The Hekla Volcano is here, all 5,000 feet of it. It's quiet now, but only four years ago its eruption cloaked the countryside for miles around. And you can stare it straight in the eye from the ship's helicopter!

Eric the Red discovered Greenland, because he had no place else to go. You can pursue him up the fjords to his farm at Brattahild. It's still there, remnants of it, and so are ruins of other Viking farms and longhouses. Even the first Christian church in Greenland.

To Greenland, Newfoundland (with the only documented Viking relics on the Continent). And Vinland. Discovered four hundred years before Columbus, almost a thousand years before you.

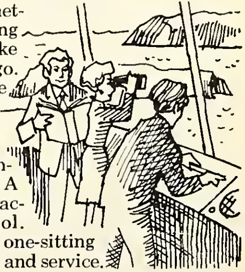
What's so unusual about the M/V Bewa Discoverer?



It's for unusual people. People who dare to think. And learn. The real adventurers of this day and age whose minds are even more restless than they are. So: On the Discoverer you learn from every phase of the voyage. There's a duplicate bridge for passengers, complete with charts, log, and radar. The very same kinds of instruments that guide your captain.

Amidships you'll find a laboratory with naturalists and scientists working on projects relating to your expedition. And all the experts are there to share their expertise with you. To involve you for a month in things that involve each of them for a lifetime.

The same goes for the crew. There's an intercom system to give you the ear of an officer for any questions you may have. In fact, you're almost a part of the crew.



There's also a sea life netting station aboard. A fishing platform. Super-launches to take you where the ship can't go. And that helicopter to take you where nothing else can go.

Not to mention the comforts, niceties and pleasures you might expect on a conventional luxury cruise liner. A spacious cabin. All of them facing outside. Swimming pool. Gym. Sauna. Three bars. A one-sitting restaurant with exquisite food and service.

The places and Thomas Cook.

The Viking expedition is one of 9 new Bewa Discoverer expeditions in 1974 offered exclusively by Thomas Cook. You can learn first hand about the life and lore of some of our continent's earliest settlers, the Eskimos. You can thread your way farther north to the Arctic circle (the ship is even equipped to crack through ice). Or you can select the most unusual itinerary since 1492 and discover America in the Wake of Columbus.

These are all very special vacations, but then, so are the people who bring them to you. From the first Cook's Tour till now. The Thomas Cook reputation spans the world. It is the largest travel organization in the world. Over the years literally millions have counted on Thomas Cook for the highest standards of dependability and service. The M/V Bewa Discoverer is in this fine tradition.

Send this coupon for more information. Or visit your travel agent or your nearest Thomas Cook office.

Thomas Cook

WORLD TRAVEL

Thomas Cook
587 Fifth Avenue
New York, New York 10017

BEWA CRUISES

NH 1

Gentlemen: Please send your brochure giving complete details on the new M/V Bewa Discoverer Pleasure Expedition Cruises.

Name____________________

Address____________________

City__________ State______ Zip______

My Travel Agent is________________

M/V Bewa Discoverer is a special expedition cruiseship registered in Denmark.

Now the beauty and glory of America's natural treasures are yours to enjoy as never before

The wilderness areas that lie in and around the United States of America are one of our greatest treasures. The mountains, forests, shorelines and other sanctuaries are priceless not only as preserves where wild plants and animals can flourish but also as a source of spiritual refreshment for you.

Now you and your family can enjoy the wilderness all year long and explore it extensively in THE AMERICAN WILDERNESS, a spectacular series by TIME-LIFE BOOKS. As a subscriber, you'll experience through words and pictures the scenic delights, the natural history, the flora and fauna of some of the world's most inspiring natural wonderlands.

You'll visit *Wild Alaska,* home of the world's largest bears, and of wolves that eat 25 pounds at one feeding...*The Northeast Coast,* teeming with fascinating life forms at the border where ocean meets forest...*The Grand Canyon,* which slices a mile into the earth's crust, revealing rocks that are two billion years old...*The North Woods,* where the tall, dark trees march up into Canada from the northern edge of Minnesota...*The Atlantic Beaches,* from Boston to North Carolina, where the tides and wind are constantly reshaping the shoreline...*Baja California,* where ruined missions, bleached bones and abandoned mines give evidence of man's unsuccessful efforts to triumph over inhospitable nature. And other books in the series will take you to many other wondrous wilderness areas.

Explore *The High Sierra* for 10 days FREE

To start your tour of THE AMERICAN WILDERNESS accept, for a 10-day free examination, the introductory volume in the series, *The High Sierra.* Explore the Sierra's 400 miles of cliffs and forests and meadows...home of the giant sequoias, the site of spectacular Yosemite, and a last stronghold of the West's big cats.

Then decide if you want to keep *The High Sierra.* You may do so for only $5.95 plus shipping and handling, or you may return it within 10 days with no further obligation. If you keep *The High Sierra,* we will send you other volumes in the series as described on the reply card. There is no obligation for you to buy any of these books, and you may cancel your subscription at any time. To take advantage of this offer, just fill out and mail the reply card today. If card is missing, write for details to TIME-LIFE BOOKS, Dept. 3504, Time & Life Building, Chicago, Illinois 60611.

Alaskan red fox pup. Fox families are close-knit. Parents stay together and share in devotedly caring for their pups.

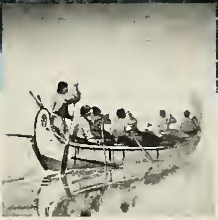
As your introduction

Explore the High Sierra free for 10 days

as a guest of TIME-LIFE BOOKS

TIME
LIFE
BOOKS

The blue-footed booby of Baja California looks awkward and comical on land, but gives a superb performance when fishing at sea.



Early painting shows freight canoemen in the North Woods. These "voyageurs" were small but strong: one carried a load of 820 pounds uphill for a mile.

Giant sequoias are the largest living things on earth, with trunks so thick that a stump was once used as a dance floor.

- 40,000 words of text
- written by avid outdoorsman Ezra Bowen with noted conservationist Martin Litton as consultant
- 9 x 10⅜ inches, hardbound
- 184 pages
- More than 100 illustrations—photographs, paintings, maps, including 87 pages in full color.

Books shown on the opposite page are just some of the beautiful volumes available.

As your introduction to
The American Wilderness

TIME
LIFE invites you to
BOOKS

Explore the
High Sierra

Free for 10 Days

THE HIGH SIERRA
THE AMERICAN WILDERNESS/TIME-LIFE BOOKS

A Last Stronghold for the Big Cats

TIME
LIFE Time & Life Building,
BOOKS Chicago, Ill. 60611

Yes, I would like to examine **The High Sierra**. Please send it to me for 10 days' free examination and enter my subscription to THE AMERICAN WILDERNESS. If I decide to keep **The High Sierra**, I will pay $5.95 ($6.95 in Canada) plus shipping and handling. I then will receive future volumes in THE AMERICAN WILDERNESS series, shipped a volume at a time every other month. Each is $5.95 ($6.95 in Canada) plus shipping and handling and comes on a 10-day free-examination basis. There is no minimum number of books that I must buy. I may cancel my subscription at any time simply by notifying you.

If I do not choose to keep **The High Sierra**, I will return the book within 10 days, my subscription for future volumes will be canceled and I will not be under any further obligation. 3505

Print Name______________________________

Address______________________________

City______________________________

State________________Zip__________

Canadian residents: please mail this form in an envelope.

Schools and libraries: Order Library Style bindings from Silver Burdett Company, Morristown, N.J. 07960. Eligible for Titles I, II funds.

FIRST CLASS
Permit No. 22
Chicago, Ill.

BUSINESS REPLY MAIL
No Postage Stamp Necessary if Mailed in United States

Postage will be paid by

TIME-LIFE BOOKS
Time & Life Building
Chicago, Illinois 60611

The North Woods...

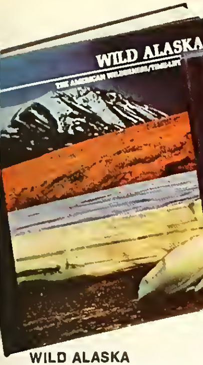
The Grand Canyon...

The Northeast Coast...

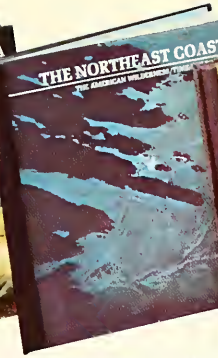
HEED THE CALL OF "WILD AMERICA"

Let TIME-LIFE BOOKS show you the glory and majesty of wild areas like these—with a view to inspiring you to know and love "wild America" and, hopefully, to help save and preserve it.

Start by enjoying The High Sierra Free for 10 days


WILD ALASKA
THE AMERICAN WILDERNESS/TIME-LIFE

WILD ALASKA
America's last frontier—a land of three million lakes, 119 million acres of forest . . . and still 99 per cent uninhabited.


THE NORTHEAST COAST
THE AMERICAN WILDERNESS/TIME-LIFE

THE NORTHEAST COAST
from storm-racked Maine to Newfoundland . . . home of the harp seal, the clownlike puffin, other fascinating shoreline creatures.

THE NORTH WOODS
THE AMERICAN WILDERNESS/TIME-LIFE BOOKS

THE NORTH WOODS
from northern Minnesota to Lake Athabasca in Canada . . . where beaver, moose, wolves and other animals roam the stands of lofty pines and glades of birch and aspen.

THE GRAND CANYON
THE AMERICAN WILDERNESS/TIME-LIFE BOOKS

THE GRAND CANYON
The majestic "wilderness in stone" that has been called the world's largest and oldest history book.

ATLANTIC BEACHES
THE AMERICAN WILDERNESS/TIME-LIFE BOOKS

ATLANTIC BEACHES
The surprisingly extensive stretches of unspoiled beach where the forces of nature can be seen at work as man saw them 100 years ago.

TIME
LIFE
BOOKS **presents**

The American Wilderness

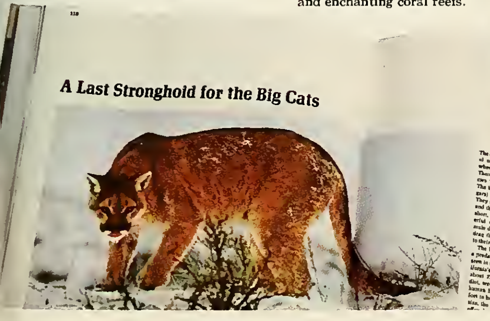
CACTUS COUNTRY
THE AMERICAN WILDERNESS/TIME-LIFE BOOKS

CACTUS COUNTRY
The weirdly beautiful desert country in southern Arizona and northern Mexico . . . home of buzzards, Gila monsters and 140 kinds of cactus.

THE EVERGLADES

THE EVERGLADES
A watery wilderness where alligators, panthers and spectacular rare birds find refuge in the marshy grasslands and swampy jungle.

HAWAII
"A handful of jewels on the green velvet sea"—a magical, mysterious land of fire-spewing volcanoes, Eden-like forests, isolated atolls and enchanting coral reefs.


A Last Stronghold for the Big Cats

THE HIGH SIERRA
THE AMERICAN WILDERNESS/TIME-LIFE BOOKS

THE HIGH SIERRA
A natural wonderland with a waterfall 15 times as high as Niagara, a bird that flies underwater, mushrooms that can wreck a train.

The Unscientific Method

By ignoring accepted rules of evidence, the authors of a popularized book on plants reach many false conclusions

Did you know that plants can respond to human speech, thoughts, emotions, and prayers? That they are capable of purposeful alteration of their behavior? That they can count, communicate with each other, and receive signals from distant life-forms on other stars and in other galaxies? That they can respond selectively to certain forms of music, develop conditioned reflexes, and predict cyclones, tornadoes, earthquakes, and volcanoes? Did you know that plants have accomplished the dream of the alchemists: transmuting one element into another? And did you know that you can rid plants of insect pests or fertilize the soil in which they grow simply by exposing pictures of the growing plants to particular frequencies of electromagnetic radiation? All this, and lots more, is laid out for you in *The Secret Life of Plants,* written by Peter Tompkins and Christopher Bird, and recently published by Harper and Row. Judging by the garish full-page advertisements trumpeting its appearance and by the large stacks of copies available in stores, the book is well on its way to becoming a best seller. Well, that's show biz. But the harm this volume is capable of doing may outlast both the profits and the authors.

How can any two reasonable authors advance so many patently false, unprovable, or impossible conclusions? The answer is by ignoring all the ordinary rules of evidence and by damning, circumventing, or flouting the scientific method whenever it serves their purpose to do so.

The experiments of Cleve Backster on electrical phenomena form the foundation for much of what Tompkins and Bird have written. On December 11, 1973, Backster, a former CIA polygraph expert, told the *Christian Science Monitor* (page 9, 2nd section): "The only problem in this kind of research is that Mother Nature doesn't want to jump through the hoop ten times in a row simply because someone wants her to. It's difficult to structure repeatable experiments. There are some phenomena that occur that make this kind of thing very difficult. For instance, once you are sure something will happen, it very well may not. I suspect that's because you are communicating to the biological material as long as you keep your consciousness involved in the experiment."

Isn't that neat? According to that explanation, anyone doing experiments can "prove" anything he wishes simply by getting a result once—or perhaps once in a while. What about the times the experiment doesn't work? Mother Nature is just being a little coy. What about another experimenter who tries to repeat your work and can't? Well, that person may not have the proper mental attitude or may not be properly attuned to the plant being employed. As Marcel Vogel, another Tompkins-Bird hero who is trained in electronics but not botany, puts it: "Hundreds of laboratory workers around the world are going to be frustrated and disappointed . . . until they realize that empathy between plant and human is the key, and learn how to establish it. No amount of checking in laboratories is going to prove a thing until the experiments are done by properly trained observers. Spiritual development is indispensable. But this runs counter to the philosophy of many scientists, who do not realize that creative experimentation means that the experimenters must become part of their experiments."

Well, that at least is putting it squarely and honestly. What do you want to believe? Results that are obtained when carefully described experiments are repeated by competent investigators anywhere in the world? Or results that can be obtained only by a select few in "special contact" with their test material? Scientists are well acquainted with results that occur only occasionally. They have learned that under such circumstances it is easy to fool yourself into thinking you have obtained a positive result, when all that has really happened is that a random variation, either in biological material or experimental conditions, has cropped up. It is therefore an unwritten rule not to believe anything until you have been able to repeat it several successive times. And when both negative and positive results are interspersed, it is necessary to resort to appropriate statistical procedures to validate or at least describe the uncertainty attached to any conclusion that seems to flow from the data. It is also axiomatic among scientists not to really trust any results that have been reported successful in only one laboratory. Published results must describe the experiments and organisms in such detail that conscientious researchers elsewhere can get approximately the same results. When the same results are produced several times in different laboratories, scientists begin to accept the original conclusions. But no answer in science is considered absolute, final, or immutable. Everything is challengeable and nothing is sacred. Through such hard-nosed procedures, science has come up with generalizations and procedures that have transformed all aspects of our physical and intellectual world.

This is not to say that flashes of intuition are ruled out as a valid

fine feathers
satou

CONSERVATION IS A 300-YEAR-OLD WORD IN THE RSA

From the journal of Jan van Riebeeck, founder of the South African Nation: October 26, 1657 . . . "The commander today went to inspect a forest . . . the free carpenter, Leendert Cornelissen of Zevenhuijsen, wished to have the sole right to obtain timber from it, in such a way that the forest would suffer no damage, but would be improved . . ."

Thus Kirstenbosch – now Cape Town's famed botanical gardens – was almost certainly the first South African soil to which an avowed programme of plant conservation was applied.

What Van Riebeeck started, the people of South Africa continued. Today the RSA is one of the most extravagantly life-filled places in the world . . . 850 species of birds. 350 at one lake alone . . . 800 species of butterflies . . . 1 500 species of fish . . . 18 000 different kinds of plants . . . the greatest variety of African animals. All preserved much as it was in Van Riebeeck's day in national parks and game reserves – one of them, Kruger National Park the size of Massachusetts. A 3 000 mile coastline spanning two oceans, mountains, bushveld deserts . . . and sophisticated cities with international hotels.

One of the "Crown Jewels" of South African ornithology, an Orange-breasted Sunbird sipping nectar from an erica.

Write now for our free 52-page full-colour magazine "Discover the RSA". It will show you that a visit to South Africa is an experience no serious conservationist can afford to miss.

*South African Tourist Corporation, Rockefeller Center, 610 Fifth Ave.,
New York, N.Y. 10020,
or Suite 721, 9465
Wilshire Boulevard,
Beverly Hills,
California
90212.*

DISCOVER THE REPUBLIC OF SOUTH AFRICA

We'd like you to know

What we found in this Florida peanut field wasn't peanuts.

Up until 1970, Jay was a small, peaceful city on the Florida Panhandle where peanuts, soybeans and cotton were grown.

Visit Jay today and you'd still see a small, peaceful city on the Florida Panhandle where peanuts, soybeans and cotton are grown. Plus some new things which you wouldn't see unless you searched for them. Oil wells.

The Jay Field, which extends into southern Alabama, is the biggest oil discovery on the U.S. mainland in more than ten years. And it's now good for more than a billion gallons of oil a year.

Welcome to
JAY
Oil Capital Of Florida

The important story about Jay is not just the oil field. It's how an oil field can fit into a quiet farming community without turning it upside down.

Before the field became operational, Exxon and other oil companies commissioned an extensive study of the existing environment around Jay. The quality of the water, the land and the air were all measured and evaluated. Today, Exxon uses these measurements as a guideline in the operation of all their Jay facilities.

We think this is a good example of how the oil industry can coexist with a rural environment. Because the oil from this field is needed to help meet the energy needs in America. And we're proving we can get it without messing up a way of life in Jay.

EXXON

means of inferring the truth about nature. The nineteenth-century German chemist Kekulé, long puzzled about the structure of the benzene molecule, is said to have formulated his now widely accepted ring structure for benzene after dreaming about a snake swallowing its tail. But without subsequent experiments to support it, the dream-derived intuition would have been of little value to Kekulé. The situation is the same today. Ideas are relatively cheap. It is only through experiments that test their validity that they acquire scientific value.

The trouble with *The Secret Life of Plants* is that it consists almost exclusively of bizarre claims presented without adequate supporting evidence. Thus, if the unwary reader believes much of what Tompkins and Bird have set down, he will be cluttering his mind with mythology rather than science. And if the reader attempts to order his life on the principles and generalizations they put forth, he will be led seriously astray. This book bears the same relation to scientific botany as astrology does to astronomy. Many of our daily newspapers, of course, carry regular astrology columns, but none, to my knowledge, supports a daily column on astronomy or even on science in general. Astronomers tell me ruefully that the American public annually spends more money on astrology, through purchase of publications, for instance, and the preparation of horoscopes, than is spent each year on astronomical research. I suspect that those individuals who permit astrologers to guide their daily lives through the preparation of horoscopes will also permit Tompkins and Bird to guide their thinking about plants.

As a professional plant physiologist, concerned with an analysis of such plant-life processes as flowering, leaf movements, rhythmic behavior, and hormonally controlled growth, I can only react with incredulity to the Tompkins-Bird description of botany: "Why botany, a potentially fascinating subject dealing with plants, living and extinct, their uses, classification, anatomy, physiology, geographical distribution, should have been from the beginning reduced to a dull taxonomy, an endless Latin dirge, in which progress is measured more by the number of corpses cataloged than by the numbers of blossoms cherished, is perhaps the greatest mystery in the study of plant life." This statement stems either from ignorance or from willful misrepresentation. For the study of botany, as almost any university catalog in the subject spells out, is precisely the study of plant structure, function, distribution, evolution, physiology, and biochemistry. Taxonomy, so castigated by the authors, is an essential foundation for the understanding of plant group relationships and evolution. Some of the data may seem dull to gather, analyze, and read about, but in their relation to evolutionary thought, they furnish character and plot to one of the most exciting and elegant stories ever told.

To say, as the authors do, that "what makes plants live, or why, does not appear to be the purview of science" is to pretend that vast libraries of books on plant physiology, growth, and development do not exist. I have an eighteen-volume encyclopedia on the subject of plant physiology in my office, as well as more than twenty-five textbooks and monographs. Each year I read the *Annual Review of Plant Physiology*, which is about 600 pages long, and each year I attend a meeting of the American Society of Plant Physiologists, which has about 3,000 members. Similar societies exist in almost every country in the world, and almost every society publishes its own monthly journal. Each year, through articles in these journals, we learn more about the structure and chemical composition of plants; how they grow, metabolize, and change; why they go into and out of dormancy; why leaves turn color and fall; and why plants become senescent. Indeed, plant physiology is now the largest branch of botany. Can Tompkins and Bird be innocent of this information?

The authors obviously know some science, but they present it in such a fragmented and selected form as to create consistently incorrect impressions. For example, they mention the experiments of the late Alexander Gurewitsch, a Russian biologist who claimed to have proved that dividing cells emit "mitogenetic radiations" that cause other cells to divide, and they cite

THE SECRET LIFE OF PLANTS
STEVENSON

Drawing by Stevenson; © 1974 The New Yorker Magazine, Inc.

20 ways to
on your

1 Avoid paying extra installation charges when you order new phone service. Have all the work done at one time. Changing your mind later will mean extra visits and extra charges. So consider carefully all the different colors and styles, how many phones you want and exactly where you want them installed.

2 Ask one of our business office Service Representatives to explain the different types of service offered by your local Bell Company. Choose the one which best fits your pattern of calling. If you don't do a lot of calling each month, ask if "budget" or "limited" service is available in your area at a lower rate.

3 Ask the Service Representative for a rundown on the specific rates and charges you can expect. Find out exactly what the regular monthly charges will be, and what the one-time-only payments are. Find out whether there are options in your area of paying on a monthly basis, or making a single one-time only payment, on certain items.

4 Are you going to be away from home for any extended period of time? A business office Service Representative can tell you, based on how long you plan to be away, whether you could save money by temporarily suspending your telephone service.

5 Moving to a new residence? Ask a Service Representative whether you are eligible for a credit on your bill if you take your present phones along with you to your new location.

6 If you've never had a phone in your name before, or have never established credit, you may be asked to pay a deposit when you order telephone service. But we don't like to keep deposits for long periods of time. In fact, if you establish good credit with us by paying on time, we'll return your deposit to you PLUS interest. Ask a Service Representative to explain the details which apply in your area.

7 If a coin phone swallows your money but doesn't give you your call, you're entitled to a refund. Find a phone that works, dial "Operator" and explain what happened. You'll get a refund in the mail. P.S. We'd appreciate it if you'd also tell the operator the telephone number and location of the phone that's out of order so we can get it fixed as soon as possible.

8 Reach a wrong number on a Long Distance call you just dialed? Don't just hang up. Ask for the area code and the number you reached in error. Then dial "Operator" and report what happened. The operator will have the charge removed.

9 Get a poor connection on a Long Distance call, or get cut off in the middle of your conversation? Don't just hang up and call back. The person who placed the call should report what happened to an operator. The operator will issue a credit for the time your call was interrupted.

10 Error on your bill, with a charge for a Long Distance call you didn't make? Call the business office. A Service Representative will arrange to get the charge removed.

11 Save on Long Distance charges by cutting down on person-to-person calls. It's true you may not be able to reach the person you want on your first try with a station-to-station call. But in many instances you can make two (or even three) out-of-state station-to-station calls for what it would cost you to make that one person-to-person call. This is particularly true if you dial your own calls instead of going through an operator.

12 Dialing your own out-of-state Long Distance calls is the least expensive way of all. If you don't know the number for a call you want to make to a distant city, you can obtain it at no charge to you by dialing the area code (when required) for that city, plus 555-1212, for Directory Assistance. Then dial direct and save. Save time

save money phone bill.

in the future by recording the number in your personal number book. A listing of all area codes can be found in the information pages at the front of your local telephone directory.

13 Make sure you know when dial-direct rates apply before you make your call. They apply on all out-of-state calls to anywhere in the United States (excluding Alaska) if they are completed from a residence or business phone without an operator's assistance. They also apply on calls placed with an operator from a residence or business phone when direct dialing facilities are not yet available.

14 But it's even more important to know the circumstances when direct-dial rates do NOT apply. They do not apply on person-to-person, hotel-guest, credit card or collect calls, or on calls charged to another number, because an operator must assist on such calls. Direct-dial rates do not apply on calls made from coin phones, even those from which you dial the complete number yourself before the operator comes on.

15 While operator-handled calls cost you more than those you dial yourself, there is one exception. If you run into equipment trouble completing a Long Distance call you're dialing yourself from a home or business phone, you're still eligible for the dial-direct rate even if you require an operator's assistance. Explain your problem to an operator. If you need help in getting the call through, or in making a satisfactory connection, confirm with the operator that it will be charged at the dial-direct rate.

16 Dial direct, but save even more by making your out-of-state Long Distance calls within the time periods when rates are lowest. The lower rates for out-of-state calls made in the evening, on the weekends or late at night are described for you in the call guide in the front of your local directory.

17 Don't get caught by surprise, or miss out on the money you can save on Long Distance calls you make within your state. The times when lower rates apply may be different than for your out-of-state calls. Check carefully in the call guide in the front of your local directory for a description of when to save on calls you make within your state.

18 If you're concerned about avoiding added charges on your Long Distance calls in general, don't guess how long you've been talking. Time yourself, so you can finish your call before overtime rates apply. To save even more time and money, jot down what you want to say before you dial.

19 Before you go ahead and place a Long Distance call to a business, check first to see if they have a toll-free number. You can recognize it because it has an 800 prefix instead of a regular area code. If they have one, it's usually displayed in their advertising, or you may find it listed in your own local telephone directory. If so, the call's on them, and you save.

20 The information pages at the front of your local telephone book are a good source for tips on how to place your calls and how to save time and money in using your telephone. Look in the book, and save.

We hear you.

We're a bridge between science and you.

We're Educational Expeditions International, a non-profit organization that offers men and women of all ages the opportunity to join prominent scientists in research projects around the world. Become part of an expedition team in archaeology, anthropology, astronomy, ecology, geology, and marine sciences and contribute physically, intellectually, and financially to science. No professional qualifications are required. Team members are taught what they need to know to be productive in the field.

Ecology. Edward Cronin, Jr. and Howard Emery, M.D. of the Association for the Conservation of Wildlife, Bangkok, continue their ecological study, with emphasis on bird life, in the Himalayan forests of Nepal. April 15 to May 5. $1190*

Marine Biology. Dr. Richard Chesher needs four teams of SCUBA divers to participate in an underwater survey of the coral reefs of Florida, now in jeopardy. March 16 to 30; April 6 to 20; September 14 to 28; October 5 to 19. $690*

Archaeology. William Waldren, director of the Deya Archaeological Museum and Research Center, will conduct a field school investigation of prehistoric cave sites on the Mediterranean island of Mallorca. March 24 to April 6; July 21 to August 9; August 11 to 30; September 22 to October 5. $690, spring and fall; $790, summer*

Dr. Alfonz Lengyel, head of the American section of a four-nation UNESCO project at Carthage, begins a 5-year excavation of this ancient Punic and Phoenician site. May 19 to June 1; June 2 to 15; June 16 to 29. $690*

Geology. Dr. Frances Dakin leads a search for the volcanic core of the Simien Mountains of Ethiopia. April 7 to 24. $990.*

*plus airfare

eei

For information about these and other expeditions, write:
Educational Expeditions International Dept. NH-1
68 Leonard Street / Belmont, Massachusetts 02178
Phone: (617) 489-3030

After you get your shots, get the Bug.

On the way home from the doctor's office, stop in at your local Volkswagen Dealer.

He can arrange to have a Bug (or any other VW) waiting for you when you arrive in Europe.

He can also take care of things like licensing, registration and insurance.

From there on you make your own schedule.

Paris for a few days. Rome for a long weekend. Wherever your impulse takes you.

With a Volkswagen, you come and go as you please.

And when the tour's over, we'll even arrange to have your VW shipped back to the States.

That way, you can start saving dollars and cents.

Instead of francs and lira.

Volkswagen of America, Tourist Delivery
Dept. NH-7, Englewood Cliffs, N.J.
Please send me your illustrated brochure and a price list.

Name

Address

City State Zip

only other investigators who agree with him. They say nothing about the crucial experiments of Alexander Hollaender, the retired former head of biology at Oak Ridge National Laboratory, which disproved the existence of mitogenetic radiations. They attribute to L. Ron Hubbard, a former science fiction writer and the founder of Scientology, the discovery that light from sodium vapor lamps is harmful to plants. This information was described many times before Hubbard's mention of it, and its basis is well understood.

A contemporary Russian, Panishkin, is cited as evidence for the conclusion, surprising to the authors, that some plants do not flourish in uninterrupted light; they also need some darkness. References to similar work abound in the literature of plant physiology and are even cited in many textbooks, including my own. The authors talk about plant rhythms without ever mentioning Erwin Bünning, the distinguished German plant physiologist who spent his whole life investigating their physiology and establishing their significance. They talk about day length without mentioning Garner and Allard, the researchers who discovered photoperiodism, and they are apparently ignorant of the existence of the pigment phytochrome, which plays such an important role in this process. They describe certain experiments in plant bioelectrics without mentioning the bulk of the recent work in the field. They are flatly wrong when they say that the plant growth hormone, auxin, is "summoned and even transported by the cell-generated electric fields to the place where growth is known to occur." This was disproved several years ago by the work of Grahm and Hertz in Sweden, but Tompkins and Bird are obviously not familiar with the recent literature.

In time, the effects of this book will fade away—you can't fool too many people for too long a time. Meanwhile, some plant lovers will croon to their cattleyas and murmur to their mimosas. This may comfort the vocalizers, but it won't do a thing for the plants . . . unless Tompkins and Bird have more hard evidence than they have yet shared with us.

Columnist Arthur W. Galston teaches biology at Yale University.

British History Illustrated
The Great Fire of London

A magazine about the World's Richest History

British History Illustrated

No part of our globe, no individual living on it, has not been affected in some way by the existence and course of the British Empire, the British people, and the English language.

British History Illustrated

Please enroll me as a charter subscriber to BRITISH HISTORY *Illustrated,* send me a copy of Volume I, Number 1, and bill me for the $7.50 annual cost, a savings of $1.50 off the regular subscription price.

NAME ______________________

Address ______________________

City __________ State ______ Zip ____

6821

Some facts about

British History

Illustrated

The editor: Barrie Pitt, well-known English military historian. Editor of Ballantine Books on World War II. Author of major works about World War I.

The publisher: Robert H. Fowler, editor of AMERICAN HISTORY *Illustrated* and President of The National Historical Society.

Editorial and art offices for BHI are in England. Distribution in North America under the auspices of Historical Times, Inc. Publication bi-monthly at a subscription rate of $9.00 a year; available at selected newsstands for $1.50 per copy.

FIRST CLASS
Permit #251
Gettysburg, Pa.

BUSINESS REPLY MAIL

No Postage Stamp Necessary if Mailed in the United States

POSTAGE WILL BE PAID BY

British History Illustrated
Historical Times Inc.
206 Hanover Street
Gettysburg, Pa. 17325

Cheers to the Bloke in the Black Bowler Hat

British History
Illustrated

from British History Illustrated, the new magazine that celebrates 2,000 years of British history, tradition, culture and endearing eccentricity

If you were going to rescue the boys from Dunkirk, you'd probably go wearing blue jeans like everyone else. But one bloke who fought the perilous seas that grim day in May, 1940, went dressed as **he** felt a proper Englishman should—with umbrella, striped trousers and black bowler hat.

Cheers to him—and to the kings and courtiers, poets and prelates, harlots, clowns, pirates, adventurers, saints and sinners who have made British history the world's richest, most romantic, most idiosyncratic and most valuable for present and future generations to study.

Now, at last, British history has a popular magazine of its own. Every other month, BRITISH HISTORY ILLUSTRATED takes you back in time for adventure after adventure. You'll cast spells with the Druids. Fight with the Saxons. Connive with the Plantagenets. Sail with Drake. Romance with Nell Gwynn. Gossip with Johnson. Shop with Beau Brummell. Argue with Shaw. You'll join the high command at Waterloo, Blenheim, Trafagar, Gallipoli, Suez. Be a lady-in-waiting to Mary, Elizabeth, Anne and Victoria. Learn pottery-making from Wedgewood, playwriting from Shakespeare, architecture from Inigo Jones.

As BRITISH HISTORY ILLUSTRATED unravels the mystery of how this one tiny island came to dominate most of the earth, it's as exciting as any thriller. As human, funny, poignant and tragic as any novel. But it is also historically sound, factually accurate. Edited by Barrie Pitt, one of Britain's outstanding historians. Written by scholars and serious journalists on both sides of the Atlantic. Illustrated with drawings, charts, paintings and photographs, many never in print before.

Coming soon in BRITISH HISTORY ILLUSTRATED

How George III lost America but gained the love of the British people. The one-time drunkard who pointed the way to religious tolerance in Britain. Women's lib in 18th Century England: what the Duchess really said to Queen Anne. The unsolved mystery of the lost British colony and the message on the tree. How to fail without even trying: an "interview" with a serf on a feudal manor. The nobles who wore their estates on their backs at the Field of the Cloth of Gold. The Battle of Blenheim: Marlborough's proof that the French weren't invincible after all.

The sun may have set on the British Empire, but it will never set on British history as long as there is one person left on earth who treasures freedom and human independence. If you agree that no part of our globe, no individual living on it, but is affected in some way by the existence and course of the British Empire, this Charter Subscription offering is for you.

A Charter Subscription Invitation

If you act now, you may have Volume I, Number 1, and five subsequent issues of BRITISH HISTORY ILLUSTRATED for only $7.50 — $1.50 less than the regular subscription price. You will also receive a special Charter privilege of future renewals and gift subscriptions at the lowest possible rate, no matter how high inflation drives our prices to others.

Send no money; we'll bill you later. But mail this coupon today, while this special Charter offer lasts.

BRITISH HISTORY ILLUSTRATED
Gettysburg, Pennsylvania 17325

Please enroll me as a Charter Subscriber to BRITISH HISTORY ILLUSTRATED, send me Volume I, Number 1, and five subsequent issues, and bill me later for just $7.50 — $1.50 less than the regular rate. As a Charter Subscriber, I am entitled to the lowest possible rates on future renewals and gift subscriptions and may cancel at any time, receiving a full refund on any unmailed issues.

Name ______________________

Address ______________________

City ____________ State ________ Zip ______

6821

Flashing Sea Pansies and Glow

The chemical processes of bioluminescence are known, but the reasons for its existence are still a mystery

by Milton J. Cormier

Bioluminescence, the emission of light by living things, has probably intrigued man from his very beginnings. Chinese poets more than 3,000 years ago extolled the beauty of the firefly's glow, and Aristotle wrote in *De Anima* of things that "give light in the dark." In recent centuries, many outstanding philosophers and scientists—Francis Bacon, René Descartes, Benjamin Franklin, Louis Pasteur, Charles Darwin—were also enchanted by the soft glow of bioluminescent creatures.

The firefly is the best known example of bioluminescence, but the number of terrestrial bioluminescent species is very small compared to the number found in the oceans. Until nearly the turn of this century scientists generally accepted the hypothesis that the ocean depths were completely devoid of life. But in the 1920s and 1930s this view was overturned by oceanographers who descended several thousand feet in bathyspheres to make man's first visual observations of the deep sea. These explorers discovered that not only is life abundant within certain deep layers of the ocean but that at 1,000 feet and below, nearly every living creature is bioluminescent.

Eternal darkness, great pressure, and uniform, near-freezing temperatures dominate these depths, and it is within this environment that evolutionary forces must have been highly selective for bioluminescent forms. Bioluminescence probably plays an important role in the survival of the species. The oceans also contain surface and shallow-water creatures that emit light, but they are relatively few compared to their deep-sea counterparts.

Most bioluminescent creatures produce light by similar chemical mechanisms; in a number of cases the chemical requirements for light emission are identical. In such cases light is produced by chemical oxidation in which an organic compound, luciferin, reacts with oxygen in the presence of an enzyme, luciferase. For most of the bioluminescent systems studied, the products of this oxidation are light, carbon dioxide, water, and oxyluciferin.

The oxidation of luciferin to oxyluciferin releases energy, which is held about one-billionth of a second within the oxyluciferin molecule. At this stage, oxyluciferin is in an electronically excited state, or very rich in energy; release of this energy produces light in the region of the spectrum visible to humans. Essentially none of the energy is liberated as heat—thus the term "cold light."

Bioluminescent creatures convert chemical energy into light energy, and some of them, such as the firefly, do it with nearly 100 percent efficiency. In contrast, an incandescent lamp operates with only 10 percent efficiency, with 90 percent of the energy wasted as heat. The present concern over the energy crisis makes the ability to understand how such efficient energy conversions take place more than merely academic.

While the chemical structures of luciferin and luciferase vary considerably from species to species, in a number of widely diverse species they are identical. Future analyses of these chemical structures will help scientists trace the evolution of bioluminescence, a phenomenon that occurs sporadically throughout the phylogenetic tree. Among the lower forms of life it occurs in bacteria, fungi, and protozoans and is found in about half of the animal phyla; fish are the only vertebrates to possess it. The late Prof. E. Newton Harvey, a Princeton University biologist, once said:

> It is apparent from the classification of bioluminescent species that no clear development of luminosity along evolutionary lines is to be detected but rather a cropping up of luminescence here and there, as if a handful of damp sand has been cast over the names of all living species written on a huge blackboard, with luminous species appearing whenever a grain of sand struck. . . . It is an extraordinary fact that one species in a genus may be luminous and another closely allied species may contain no trace of luminosity.

Indeed when the first few luciferin structures were analyzed, they were found to be quite diverse, and it appeared that not only was bioluminescence a randomly occurring phenomenon but also that the chemistry leading to light emission was different for each bioluminescent species. We now know from work on marine animals that this is not the case, and it is becoming increasingly clear that a strong thread of similarity exists in the chemistry of bioluminescence among marine animals.

Along the coast of Japan there abounds a pinhead-sized, luminous crustacean called *Cypridina.* This tiny animal's luciferin and luciferase are stored in separate gland cells. One type of cell is filled with colorless granules; the other, with yellow granules. When disturbed the animal simultaneously secretes both types of granules into the seawater where they mix and dissolve, forming a localized concen-

ing Midshipmen

tration of luciferin and luciferase that results in a brilliant cloud of bluish luminescence.

Cypridina luciferin has been synthesized in the laboratory. By mixing synthetic luciferin with luciferase isolated from *Cypridina*, biochemists can duplicate the animal's natural bioluminescence in a test tube.

The chemical structure of *Cypridina* luciferin is distinctly different from the luciferin structures of both luminous bacteria and the firefly, and *Cypridina* luciferin will not react with bacterial or firefly luciferase to make light. The enzymes that initiate the light reaction are very specific and generally will act only on specific types of molecules. For a long time no bioluminescent cross reactions were found between the luciferases and luciferins of different species.

Recently, however, researchers have made a surprising observation. They have found that the luciferin and luciferase from *Apogon* and *Parapriacanthus*, shallow-water fishes, which like *Cypridina* live in waters off Japan, will cross react with the luciferase and luciferin from *Cypridina* to produce a bluish luminescence identical to that produced by the *Cypridina* luciferase-luciferin reaction. The luciferin structures of *Apogon* and *Parapriacanthus* were found to be the same as that of *Cypridina*. This was the first example of apparently identical luciferins and luciferases being found in marine animals from different phyla: an interphylum luciferase-luciferin cross reaction.

These bioluminescent fishes, unlike many deep-sea forms with bizarre appearances and prominent light organs, possess no external peculiarities and appear to resemble ordinary, nonluminous fishes. But they are capable of emitting light indirectly from luminous organs inside their bodies. These organs are located within the coelomic cavity, and the light is emitted through translucent muscle tissue that serves as a lens. Chromatophores, or colored cells, within this tissue contract or expand to control the brightness of the light.

One of the major luminous organs housing most of the luciferin is connected to the gut by a small duct. Since these fish are known to eat live *Cypridina*, the question arose as to the origin of luciferin and luciferase in these glands. Do these fish naturally possess the ability to synthesize their own luciferin and luciferase or have they undergone an evolutionary adaptation in which an organ evolved to store luciferin and/or luciferase extracted from their food supply? Observations on other bioluminescent species helped to answer these questions.

A bioluminescent toadfish commonly called the midshipman (*Porichthys*) inhabits the Gulf of Mexico and the Pacific coastal waters of the United States. It gets its name from the beautiful array of more than 700 intradermal light-emitting organs, or photophores, located on its underside, which look like ornamental brass buttons. Luciferin and luciferase are located in these photophores, whose light-emitting capacity is under hormonal and neural control.

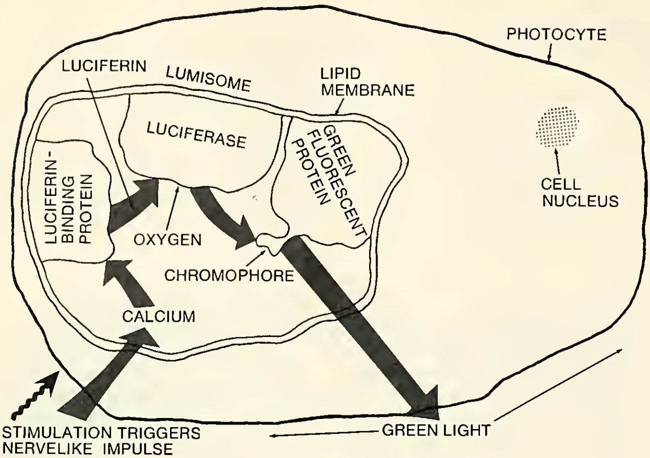
Luciferin and luciferase from the midshipman will cross react to produce light with luciferins and luciferases isolated from *Cypridina* and from bioluminescent fishes with internal light organs such as *Apogon* and *Parapriacanthus*. Thus, it is probable that all of these luciferins and luciferases are nearly identical.

The midshipman's intradermal photophores are not connected to the gut, and we might therefore conclude that the midshipman makes its own luciferin and luciferase. One of the midshipman's major food sources, however, is a small, bioluminescent shrimp, *Euphausia*. In addition, the luciferin and luciferase from this tiny shrimp appears to be identical with those of *Cypridina*, the midshipman *Porichthys*, *Apogon*, and *Parapriacanthus*. Furthermore, when the midshipman is in an environment devoid of euphausid shrimp, the luciferin disappears from its photophores and it loses the ability to bioluminesce. When these same midshipmen are fed live *Cypridina* or euphausid shrimp, luciferin is again found in the photophores and the ability to bioluminesce is restored.

Luciferin, but not luciferase, is found in all the tissues, as well as in the blood, of the midshipman, but it is most concentrated in the photophores. It thus appears that the midshipman derives its luciferin from its food source and that the luciferin is transported by the bloodstream and stored in the photophores. It is more difficult to transport large molecules like luciferase, so the animal must make its own.

Another diverse group of bioluminescent marine animals utilizes a luciferin that is structurally analogous to, but different from, that found in *Cypridina*. This most recently discovered luciferin has been found in the sea pansy, *Renilla*.

A pinkish violet, half-dollar-sized colonial coelenterate, the sea pansy lives on the ocean floor at depths of from twenty to fifty feet. At the



When the sea pansy is stimulated, a nervelike impulse releases calcium within the lumisome, an organelle one-fiftieth the size of the light-emitting cell, or photocyte. The calcium forces the luciferin-binding protein to release its luciferin to luciferase, where it oxidizes to form energy-rich oxyluciferin. The energy is transferred to a chromophore on the green fluorescent protein, producing the animal's green light. (Diagram not drawn to scale.)

University of Georgia Marine Institute on Sapelo Island, Georgia, about one ton of these animals has been collected each summer for the past fourteen years, for use in research aimed at understanding how the animal produces light and how it controls its bioluminescent flash. When a sea pansy is stimulated by mechanical or electrical means, it sends a beautiful concentric wave of greenish light out from the point of stimulation, across its body surface and upward to the tip of each individual polyp. This wave of luminescence is controlled by some kind of elementary nerve network. Scientists do not yet know why sea pansies are bioluminescent.

The chemical structure of sea pansy luciferin has recently been determined, and like *Cypridina* luciferin, it can now be synthesized in the laboratory. Thus, by combining synthetic luciferin, sea pansy luciferase, and oxygen, we can duplicate in a test tube what the sea pansy does to make light.

Bioluminescence will not occur when sea pansy luciferin is mixed with the *Cypridina*-type luciferases. Sea pansy luciferin and *Cypridina* luciferin, however, have important structural similarities. The central portion of each animal's luciferin molecules, where the chemistry of light emission occurs, is identical.

When sea pansy luciferin and luciferase are mixed with oxygen in a test tube, the color of the emitted light is blue, but the color of light emitted by the live animal is a very characteristic green. This difference in light color is caused by a green fluorescent protein found in the sea pansy. This protein has an unknown chromophore attached to it that absorbs blue light and re-emits it as green light by a process called fluorescence.

The process of bioluminescence is actually analogous to the process of fluorescence. In fluorescence, light energy is pumped into a molecule and converted to a different color. In the case of bioluminescence, chemical energy is pumped into a molecule—as in the oxidation of luciferin by sea pansy luciferase—to produce blue light. In both cases an equivalent, short-lived product is produced—an electronically excited, or energy-rich, state of the molecule.

When the green fluorescent protein is added to a solution of sea pansy luciferase and luciferin in the laboratory, the color of light changes from blue to the same green light seen in live animals. When chemical energy is pumped into oxyluciferin by bioluminescence, this energy is utilized to create an electronically excited state of the green fluorescent protein by the process of energy transfer. Thus, the light emitted is green.

The flash of green light given off by a sea pansy is triggered by a nervelike impulse. Biochemists have isolated a luciferin-binding protein in the sea pansy that is apparently responsible for initiating and controlling the light flash. As long as luciferin is bound to this protein, it is prevented from reacting with luciferase. But when calcium is added, luciferin is released almost instantaneously from this protein, thus allowing the luciferin to produce light with luciferase. In the sea pansy all the proteins necessary for making and controlling green light—the luciferin-binding protein, luciferase, and the green fluorescent protein—are packaged together within a membrane-enclosed subcellular organelle called a lumisome. When the animal is stimulated by any means, a nervelike impulse triggers the sequential release of calcium within the lumisome. Because the light is controlled by the supply of calcium ions, it thus appears as a single flash.

In most firefly species, the female's bioluminescent flashes attract the male. Each species has a particular flash pattern.

IVAN POLUNIN

The lumisomes and the other components that the sea pansy requires to produce green light have been found in all other bioluminescent coelenterates of the class Anthozoa that have been examined. These include the sea feather *Ptilosarcus,* the sea pens *Stylatula* and *Acanthoptilum* found on the ocean bottoms off the California coast, and another anthozoan, *Cavernularia,* found off the coast of Japan. These creatures produce the same quality of green light as the sea pansy.

The luciferins and luciferases found in these organisms are interchangeable with sea pansy luciferin and luciferase, suggesting identical structures. This same sea-pansy-type luciferin structure also appears to be involved in the bioluminescence of other coelenterates such as the jellyfish *Aequorea* found in Friday Harbor, Washington, and the hydrozoans *Obelia* and *Clytia* found in Woods Hole, Massachusetts.

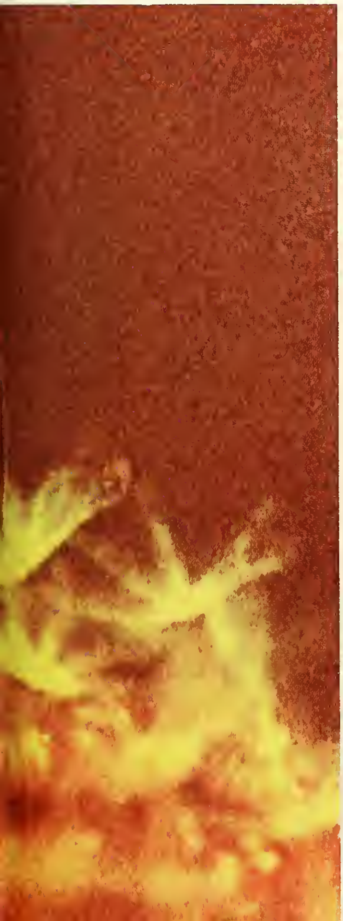
A sea-pansy-type luciferin and luciferase have also been found in a bioluminescent fish, *Yarella,* in the Gulf of Mexico. Like the midshipman, *Yarella* also contains many intradermal photophores that house its luciferin and luciferase. Here is yet another example of an interphylum bioluminescent cross reaction—the sea pansy and a fish.

Because of the complexity of the molecules, there is precedence for the idea that some bioluminescent creatures may borrow luciferins from the environment rather than manufacture them. Some luminous fish selectively take in luminous bacteria from the environment and have developed highly complex light organs to house and maintain these bacteria. Certain photosynthetic marine slugs borrow photosynthetic organelles from the al-

The luminous internal organs of Rhabdamia cypselura *emit light through translucent muscle tissue. The sea pansy, below, gives off green light because of a green fluorescent protein in its lumisomes.*

MILTON J. CORMIER

YATA HANEDA



gae they eat. Many of nature's creatures take from the environment one component of a biological system and build the rest of the system around it.

Evolution at the molecular level proceeds by small changes in preexisting molecules, and it may well be that luciferases, as well as luciferins, have evolved from molecules that once had entirely different functions. Within a given environment, for example, evolutionary pressures—probably associated with recognition of the species, attraction of food, or protection from predators—could have been sufficient to have selected for a luciferase and an accompanying system for the purpose of making light. The associated luciferin could have been either created or borrowed from the environment. This kind of phenomenon might have happened many times during evolution. Bioluminescence might have developed again and again in a sporadic fashion throughout the course of evolution. An analogous case would be the evolution of the power of flight, during which numerous animals such as insects, birds, reptiles, and mammals independently developed this capability at various times during their evolutionary development. This concept could help explain Professor Harvey's observation of the sporadic occurrence of bioluminescence among various species.

Biologists have long observed anatomical similarities between organs of vision and such organs of bioluminescence as are found in the photophores of deep-sea fish, squid, and shrimp. For example, many photophores contain a cornealike layer, or lens, and light-producing cells arranged in the manner of a retina, a reflector, and a nerve. There have been instances when biologists mistook photophores for eyes. Furthermore, the subcellular structures of some light-producing cells are arranged in a manner analogous to that of the rod and cone cells that absorb light in vision. The pigment responsible for light absorption for vision is concentrated within a membrane in one part of the cell, making light absorption more efficient. In bioluminescence, the pigment responsible for light emission—the green fluorescent protein—is concentrated within the lumisome membrane in one part of the cell so as to make light production more efficient.

Based on work with sea pansies, biochemists have extended the analogy between bioluminescence and vision to the molecular level. In vision, light absorption releases calcium, generating a nerve impulse. In bioluminescence, a nerve impulse releases calcium and light is generated.

YATA HANEDA

Various species of bioluminescent fungi, commonly known as fox fire, live on rotting logs and stumps. The chemical processes that produce their light are more primitive than those operating in marine organisms.

As knowledge about bioluminescence accumulates, we are gradually learning how to use it. Research on possible applications is continuing for three specific reasons: first, many components of luminescence have been isolated and synthesized in the laboratory; second, highly sensitive devices for detecting light have been developed; and third, the measurement of light production is the most sensitive probe available to scientists for the specific detection of a variety of chemicals.

Because of their great sensitivity, swiftness, and reliability, luminescent reactions are especially valuable in detecting minute quantities (less than one part in a trillion) of an element or compound in a large mass. Bioluminescent components are—or can be made—specific to only one element or compound and will light up only in its presence. One such example is the firefly assay for ATP (adenosine triphosphate), a chemical found in all living cells. Because ATP is ubiquitous to all life, a sensitive technique has been worked out for counting bacterial cells using firefly luciferase and luciferin. The more cells, the brighter the light due to the increased amount of ATP. Such techniques are being used to expand medical research.

Tests for infectious bacteria in the urinary tract and in the bloodstream, which once took many hours, can now be done in minutes using the firefly system. The firefly ATP assay is also being examined as a possible technique for early detection of cancer because it has been found that the light intensity of the firefly system decreases in the presence of cancerous cells.

Another important chemical common to all animal and possibly to plant cells is PAPS, a sulfate derivative of adenosine diphospate. It is essential in metabolism, the buildup and breakdown of cellular material. The sea pansy bioluminescent system is now being used to detect PAPS, and the assay has proved just as sensitive as the firefly assay for ATP.

Certain other bioluminescent coelenterates, especially the jellyfish *Aequorea*, are being used to detect low levels of calcium in biological tissue. Calcium is important in muscle contraction and vision, and the *Aequorea* system is providing new information on how these important processes work.

Although scientists have unraveled some of the chemical processes of bioluminescence and have applied this knowledge to benefit mankind, in most cases they are mystified as to why the phenomenon exists and fascinated by the possibility of finding the answer. ☐

IVAN POLUNIN

Quail Music

The complex calls of a bird contain clues to its evolution

by Paul A. Johnsgard

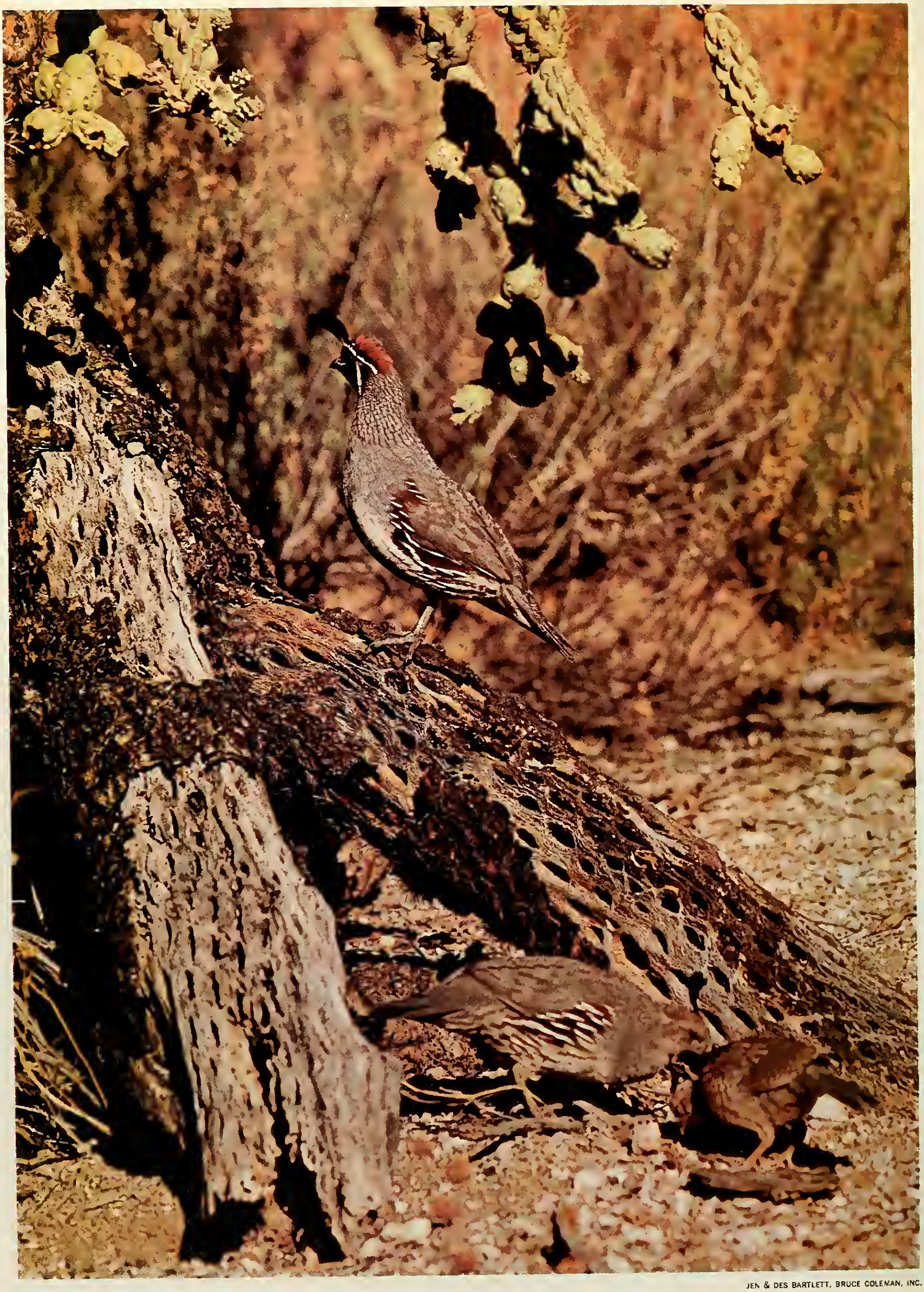
The danger implied by an owl's hooting, the peace suggested by a dove's cooing, and the good cheer represented by a robin's song are all traditional, universal interpretations of bird vocalizations that have nothing whatever to do with the actual biological functions of these utterances. Only by field or laboratory investigations is it possible to gather information about the purpose of bird calls and songs. Some are territorial proclamations or mating invitations; others serve as warnings or threats, help synchronize group movements, increase the probabilities of efficient reproduction, and improve the chances for survival.

Ethological research has revealed that these vocal communications are highly specialized behavioral adaptations that can shed light on evolutionary processes that have affected whole groups of birds. The calls of the quails of the New World are a good example.

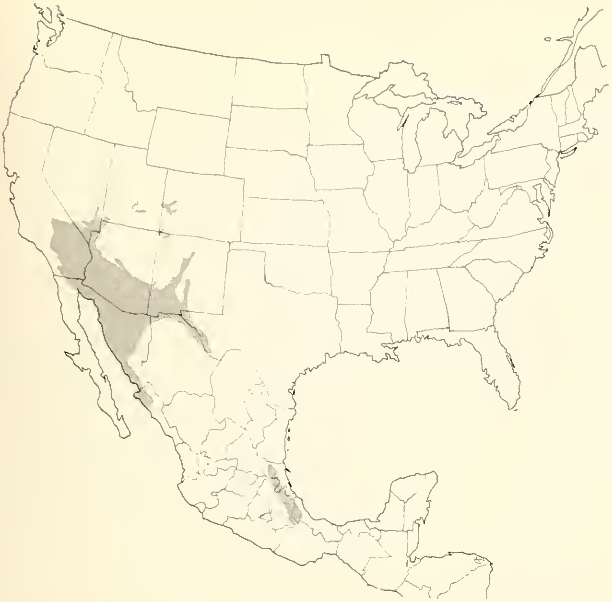
This group of birds includes some thirty species, about half of which are limited to the tropical forests of Central and northern South America. The other species are North American, ranging as far north as southern Canada. Morphological evidence favors the view that the most generalized, or "primitive," of these species are the tree quails of Mexico's moist mountain forests. The more open-country and arid-adapted species, which extend into the United States, are anatomically more specialized, or "advanced," and probably were

A separation call, uttered by both sexes, serves to reunite female (left) and male (right) bobwhites.

MARTY STOUFFER, NATIONAL AUDUBON SOCIETY



JEN & DES BARTLETT, BRUCE COLEMAN, INC.



Distribution of the Bearded Tree Quail and Gambel's Quail

The bearded tree quail is found in the mountainous cloud forest of east-central Mexico (smaller area). Gambel's quails occupy mesquite, saltbush, and thorn shrub habitats in desert valleys throughout northern Mexico and the American Southwest (larger area).

derived from forest-adapted ancestral stock somewhat like the modern tree quails.

The vocal requirements for all quail species are similar, reflecting basic similarities in their breeding biology. Effective communication between the adults and young is needed to provide maximum efficiency for protecting and rearing the brood. Calls that facilitate the maintenance and regrouping of pairs, families, or coveys are also needed, since the birds depend on social banding as a defense against predators. The effectiveness of alarm, or warning, signals in reducing individual mortality has no doubt been an important factor in the evolution of covey-forming behavior. Calls that achieve a means of individual recognition between members of a pair also facilitate monogamous pair bonds. Finally, calls serving to announce the location of unmated but sexually active males are also required.

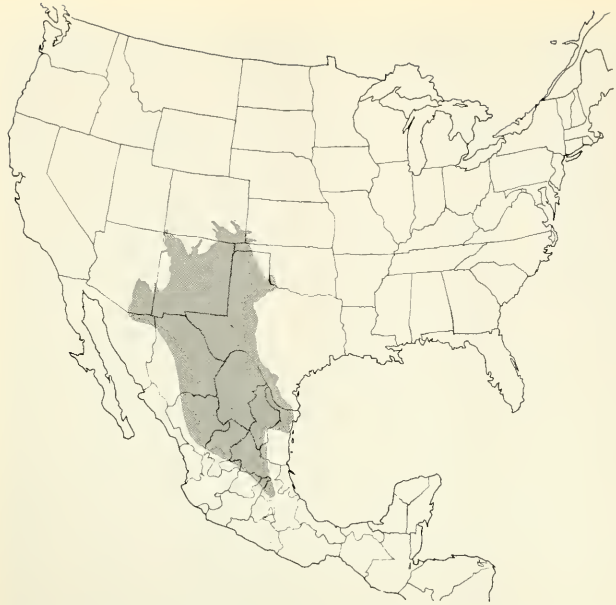
The male Gambel's quail (on perch) can differentiate the call of his mate from that of other females.

A species with a minimum vocal repertoire is the scaled quail (*Callipepla squamata*). This desert and grassland bird extends from Texas and New Mexico southward through the arid Mexican uplands to the Valley of Mexico. It has a bushy, whitish crest, larger and paler in males than in females, which is the basis for its vernacular name "cottontop quail." In the winter, the bird lives in coveys of from 15 to 150 birds and ranges over areas of from 50 to about 350 acres.

The scaled quail's repertoire consists of an unmated male announcement call, "whock"; a separation call, "pey-cos," used by individuals of both sexes when isolated from their mates or coveys; an aggressive "head-throw" call, which is primarily uttered by a male when another male approaches his mate too closely; a general alarm note, "chip"; an avian predator alarm call, "oom-oom-oom"; and a distress call, "ciew." There are probably other calls present such as soft contact notes and specialized parental calls.

This adult repertoire develops during the individual's growth. Newly hatched quails typically produce "peeping" notes when they are separated from their parents; this vocalization gradually changes to the adult separation call. Chicks also have loud distress calls, which increase in volume and frequency range as the birds mature. Their softer contact notes probably keep the brood and parents in proximity to each other and persist in adults as calls having comparable functions. The alarm calls gradually appear at various ages after hatching; and the exact time of their initial appearance is probably dependent on specific evoking stimuli.

The bobwhite (*Colinus virginianus*) is a quail associated with forest edge and brush habitats. The male bobwhite lacks a crest, and in contrast to the scaled quail, the sexes are markedly different in plumage, their winter coveys average about ten to fifteen birds, and their home ranges are about ten to fifty acres. The smaller home range of bobwhites is a probable reflection of the greater availability of food,



Distribution of the Scaled Quail

The scaled quail's range centers on the Chihuahuan desert, stretching up into the Southwest. It thrives best where there is a combination of annual weeds, shrubby ground cover, and available surface water.

while in the colder parts of their range the smaller covey size reflects the optimum number of birds required to form an efficient heat-conserving ring of birds during nocturnal roosting.

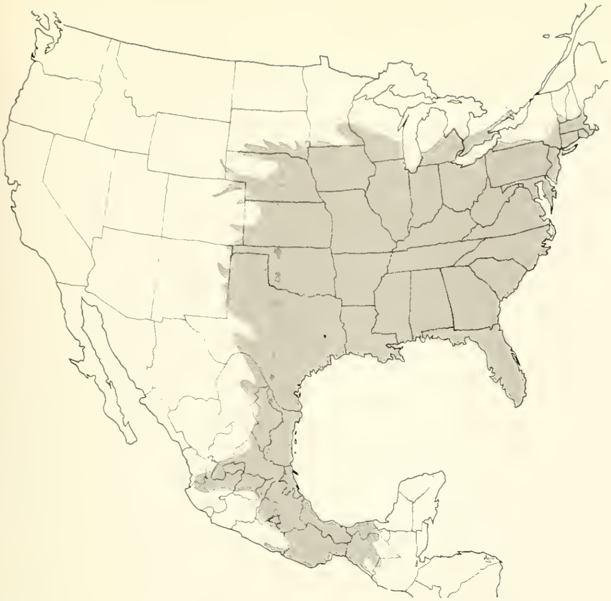
The bobwhite also has a greater diversity of vocalizations than the scaled quail. In addition to the calls typical of the scaled quail, the bobwhite has at least two contact calls, a food-finding call (typically used by females to call the young to a food source), and a female copulation call. Also, two distinctly different calls are associated with male-to-male aggression and indicate differing degrees of social dominance.

The bobwhite's separation notes also exhibit greater variation than the scaled quail's, including an increasingly louder series of "hoy," "hoy-poo," "koi-lee," and "hoyee" sounds that serve not only to reunite separated pairs but probably also to space coveys, attract males to unmated females, and repel intruders. Studies by ethologist Allen Stokes indicate that several additional calls are produced by adults brooding young, including two different alarm notes, a "broody" call, and a "take-cover" call. This surprisingly rich vocal repertoire—twenty-four different calls—is greater than that reported for nearly all bird species.

The acoustic differences between the scaled quail and the bobwhite are worthy of note. The basic adult separation notes of the two species ("pey-cos" and "hoy-poo") are somewhat comparable in their cadence, frequency, and harmonic characteristics, but sufficient differences are present to provide for species-specificity. Furthermore, the unmated male calls ("whock" and "bob-white") differ in number of syllables and frequency; and whereas the bobwhite utters a nearly pure whistle, harmonic overtones in the scaled quail's whock call produce a nasal sound.

Similar comparisons may be made with other quail species. Calls of unmated males typically exhibit marked species-specificity but show little variation among individuals, while separation calls generally exhibit sufficient individual diversity and harmonic complexity to facilitate individual recognition by mates. Distress and alarm calls are often nearly identical even among rather distantly related species. Although the typical quail distress call is loud and piercing, with a broad frequency range and resultant ease of localization, the alarm call is a series of soft "pit" or "ick" notes that carry only a short distance and are of brief duration. Distress calls tend to attract other quails and may result in attempted assistance (males may threaten or peck at a predator attacking another quail); alarm calls cause general retreat and stimulate others to utter the same notes.

If the bobwhite evolved a more diversified and complex vocal repertoire in conjunction with its close ecological ties to heavy brush and forest-edge habitat—and its associated, reduced usefulness for visual signals—it stands to reason that forest-dwelling quails should have the most complex vocal signals of all the New World quails. Current evidence tends to favor this view. Compared with open-country species, forest-adapted quails are generally large and rather inconspicuously patterned, with heavy bills and stout feet. They consume insects, berries, seeds, and other materials uncovered by scratching in the forest litter or under the soil surface. They move about in small groups (probably made up of individual families), lack elaborate



Distribution of the Bobwhite (*Colinus virginianus*)

With the largest range of all quail species, the bobwhite can be found from southern Maine through the Midwest to the Mexico-Guatemala border. Bobwhites prefer woody or brushy river valleys.

crests or strong sexual differences in appearance, and are far more often heard than seen by humans.

Some of the earliest observations on the vocal behavior of these forest-dwelling quail species were made by mammalogist H. E. Anthony on the appropriately named singing quail (*Dactylortyx thoracicus*). Observing two adult birds kept in separate cages on different sides of a house, he learned that the birds would not sing when they were in view of each other, but did sing each morning if they could not see one another. One bird would utter a series of invitational notes, which was immediately followed by a much more complex melodious series of notes by the other. The duetting continued for some time, with the birds finally stopping in unison.

Until recently, there was no suggestion that the tree quails, anatomically the most generalized of the living species of quails, produced comparably complex duets, although it was known that these species commonly uttered dawn and dusk choruses. Previous observers universally have attributed such choruses only to males, a view that has seemed improbable to some on the basis of the known duetting by related species. Thus, while doing field work in eastern Mexico, I was particularly pleased to locate and place in cages five bearded tree quails (*Dendrortyx barbatus*): two pairs and an extra female. After adjusting for a time to their new surroundings, the birds began to perform their dawn choruses. The entire group typically sang in unison for fifteen to twenty minutes at about sunrise. Presumably these dawn and dusk singing periods serve to announce the locations of pairs or families to other quails in the area and directly or indirectly may facilitate optimum population distribution. When together, members of the group almost constantly chattered in low, gutteral sounds, interspersed with a variety of soft whistles, rattles, and other vocal signals, which are undoubtedly of great importance in maintaining contact with mates or family members in densely vegetated habitats.

These examples of the vocalizations of representative quail types suggest that the forest-dwelling quails are more complex in this respect than are their open-country relatives. Since zoogeographic and morphological evidence favors the view that the open-country species were derived from forest-dwelling forms rather than vice versa, it seems that the evolutionary pattern in the quail group has been toward decreased complexity and diversity of vocalizations as increasingly arid and more open habitats have been colonized. Acoustical signals used for grouping birds at dawn and dusk have been lost, and the complex duetting behavior has been replaced by more generalized separation calls. In the case of males, the separation calls have also been variously modified to serve as species-specific signals for announcing the locations of unmated birds. While uttering such calls, these males often stand in relatively exposed vantage points, maximally exhibiting their distinctive plumages.

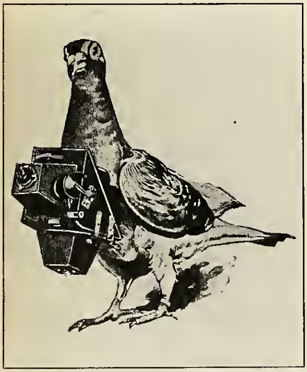
The over-all size and complexity of a bird's vocal repertoire, or language, is a compound result of its ecological needs for effective vocal signals, its anatomical limitations, and its innate or acquired potential for the use of vocal signal systems. By deciphering the calls of quails, we are coming to learn more about the actual patterns of evolutionary divergence and specialization that these birds have followed. ☐

The 1974 *Natural History* Magazine Color Photography Competition

If Henry David Thoreau had walked through the natural world of this century, rather than the last, he probably would have been a great nature photographer. He had all the right traits: patience, curiosity, powers of observation, sensitivity to the interrelationships of man and nature, and a natural sense of beauty, order, and timing.

Thoreau also had the luck of the good player. He was once walking with a visitor who asked him how he ever managed to find Indian artifacts. Why, they are everywhere, Thoreau replied . . . and he stooped down and picked up an arrowhead lying beside the path.

The 1974 *Natural History* Magazine Color Photography Competition is for today's Thoreaus, those good players who can find form, beauty, and art in the natural world—and who have photographic talent. With luck, one of those players will be walking along a path at the very instant that a great picture is unfolding. The photograph that emerges from that serendipitous moment will bring fame and fortune to its taker and pleasure to all readers of *Natural History*.



The Competition: We've tried to keep the categories wide. 1. The Natural World. 2. Man and His Environment. 3. A Chronological Sequence, which may be any series of up to five photographs of an event in nature.

The Rules: We've tried to keep them simple. 1. The competition is open to everyone except, of course, employees of The American Museum of Natural History. 2. Competitors may submit up to five, previously unpublished color transparencies in each category. 3. The mount of each color transparency must contain the name and address of the photographer, because keeping track of the thousands of entries is one big job. 4. For each entry we would like to know the make and model of camera, the film rating and the exposure time (if you remember it), and where the picture was taken. 5. Include a self-addressed, stamped envelope, since we will want to return the transparencies to you.

The Closing Date: We've tried to keep it short. All entries should be postmarked no later than April 15, 1974—just like your income tax.

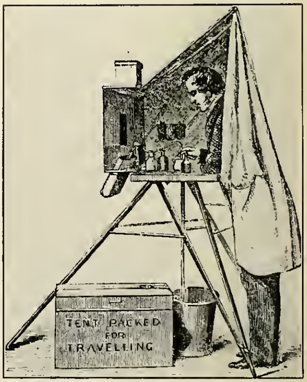
The Reward: We've tried to keep it great. Grand Prize is a round trip for two to East Africa. First Prize in each of the categories is $250. Ten Honorable Mentions will receive $100 each.

More Rewards: All winning entries will be published in a special, color-crammed issue of *Natural History* and will be exhibited at The American Museum of Natural History.

Some Hitches: The decision of the judges will be final. *Natural History* acquires the right to publish and exhibit the winning pictures. And *Natural History* assumes no responsibility for transparencies.

An important point: Pack your beautiful transparencies carefully and mail them to:

Photography Competition
Natural History Magazine
7 West 77th Street
New York, New York 10024



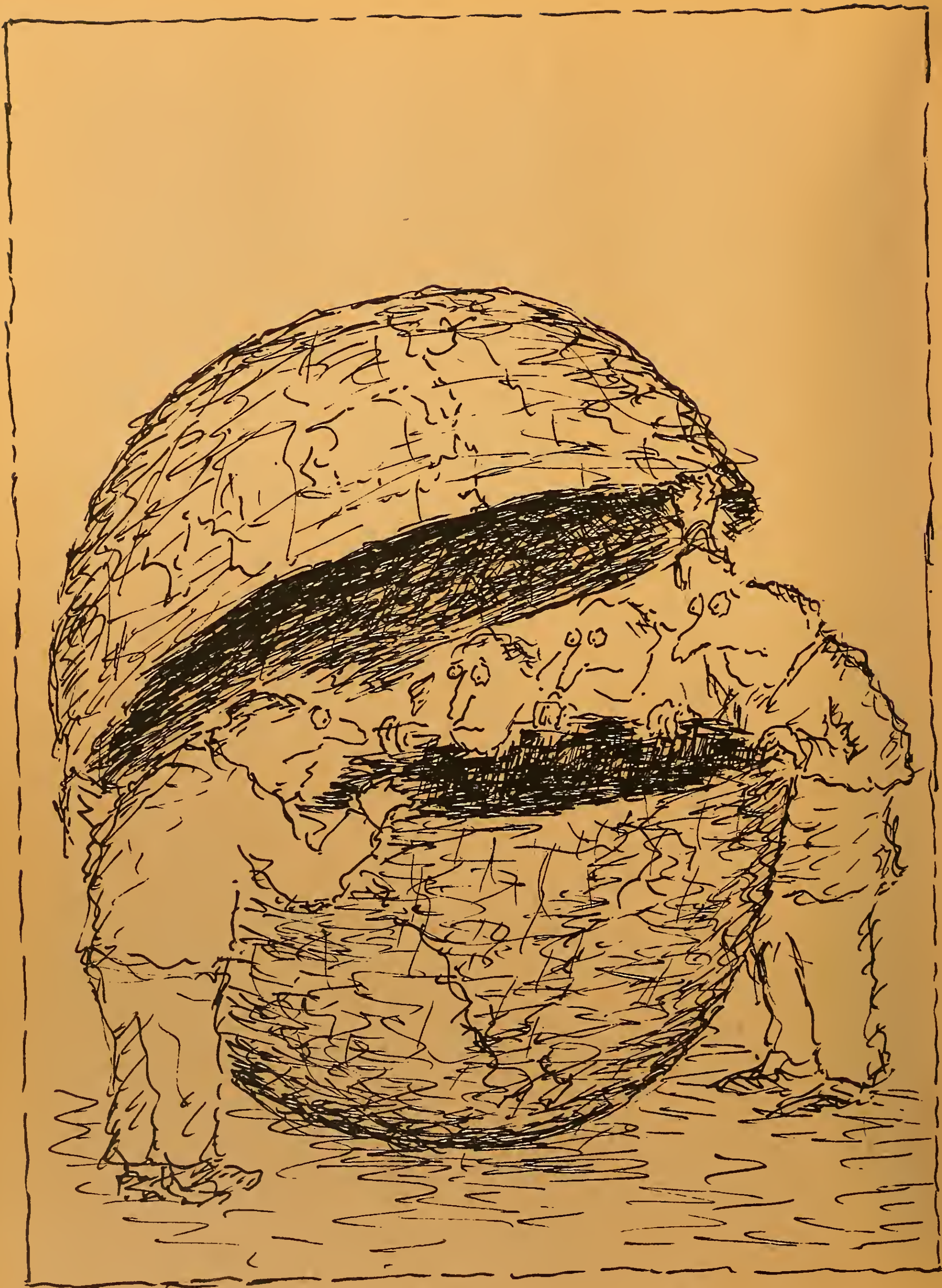
And a final thought. Good Luck.

A Global Imperative for the Environment

International cooperation is needed more than ever as we approach the outer limits of world resources and the carrying capacity of the biosphere

by Maurice F. Strong

Drawings by Edward Koren



For perhaps the past two centuries, the Western world has been bewitched by the wonders of science and technology. Lately it is the "knowledge explosion" that has mesmerized us. We find it intriguing that more scientists are alive today than have lived throughout history; that the sum total of human knowledge doubles every ten years; that inventions are made so rapidly that some industries are forced to adopt entirely new technologies every three or four years.

For at least the past few decades almost all the nations of planet Earth have been preoccupied with economic growth. Science and technology, spreading rapidly around the world, seemed to offer the key to ever expanding material well-being. At the same time, nature seemed to offer unlimited abundance. Man had merely to fashion the appropriate tools to exploit, process, and distribute his inherited riches for the comfort of all. In the process of pursuing the goal of growth, a few nations have gained material wealth beyond the dreams of prior kings and emperors. Even in the poorer parts of the world—home to some two-thirds of the human race—economic progress has, in recent decades, gone forward at an unprecedented pace.

This preoccupation with material growth, however one judges it on moral grounds, has not lacked for social and even ethical benefits. It was only in this century, let it be noted, that governments generally began to accept responsibility for the health, welfare, and economic security of those they governed. But our overriding concern for growth has brought a concomitant preoccupation with the quantitative aspects of our lives. We are obsessed with the notion that more is better. We also tend to focus on day-to-day affairs as though our vision could barely encompass tomorrow, let alone span the next generation.

Material progress has created a bewildering pattern of paradoxes of which we are only now becoming aware. Technologies once thought of as liberating are now seen as potentially enslaving. Witness the automobile. It provided mobility for millions throughout the world, but it also led to the decay of the inner cities. It determined their patterns of growth, even threatening some with complete standstill. And automobile congestion has afflicted urban inhabitants with foul air and debilitating noise levels.

Paradoxes are even more apparent in the poor parts of the world. Those areas now have more individuals with reasonably acceptable per capita incomes and more below the poverty level; more who can read and write and more illiterates; more with healthy diets and more who are undernourished; more children going to school and more denied an education. The point is that many of these nations are on a treadmill that forces them to run faster and faster if they are even to stand still. Modern medical science has brought dramatic declines in infant mortality and death rates in general, while birthrates have remained at high levels.

In the more affluent parts of the world, continuous economic growth has brought immense improvements in health, diet, and education for large numbers. Many can live without ever knowing poverty. High rates of personal income and consumption have brought comfort, mobility, leisure, entertainment, and longevity to broad segments of the population. But to many, especially the middle-class young, material well-being has brought disenchantment and alienation. High consumption depletes natural resources, pollutes the air and water with waste materials, and generally degrades the environment. A degraded environment, in turn, diminishes the quality of life.

The relentless application of purely economic criteria to the process of decision making has grossly distorted the allocation of resources, favoring the areas of highest economic return rather than those of social priority. Thus, in the use of urban land there is a bias in favor of high-density development and the provision of commercial services, while social services and recreational spaces are severely limited. This single-mindedness has tended to dehumanize life in our cities; as a consequence, there is a loss of individual and community identity and an increase in alienation and violence.

As we approach the final quarter of the twentieth century, new questions arise: How much is enough? How much production, energy, consumption, population is enough? Once basic needs have been met, is more really better? Is the maximum level of any human activity the optimum level?

One might presume that each country should answer these questions for itself. Those nations in which the continued rapid growth of population interferes with the attainment of such social goals as health, education, and employment might decide to reduce their national birthrates. Those in which the continued rapid expansion of consumption puts excessive pressures on the environment might consider employing restraints. Unhappily, the situation is not that simple. The environment issue has made it clear that cause and effect relationships are global in scale; even restricted local actions can affect and, in turn, be affected by other moves that are widely separated from them in space and time. Continued population growth in some parts of the world and a simultaneous rise in per capita consumption in others reinforce each other at the global level in ways that are producing qualitatively new kinds of problems. These can be dealt with successfully only through new forms of international cooperation and action.

It has been recognized for some time that the continued growth of production and consumption in the industrial world is also of benefit to the developing countries. Such growth expands markets and stimulates trade. It enlarges the total world supply of available goods and services, even though it cannot guarantee their equitable distribution. These concepts remain generally true only so long as there are no absolute restraints on further expansion. But restraints there must be. Some are placed on us by the very nature of our planet and the limits of its available resources. Others result from our interdependence with, and exploitation of, natural ecosystems.

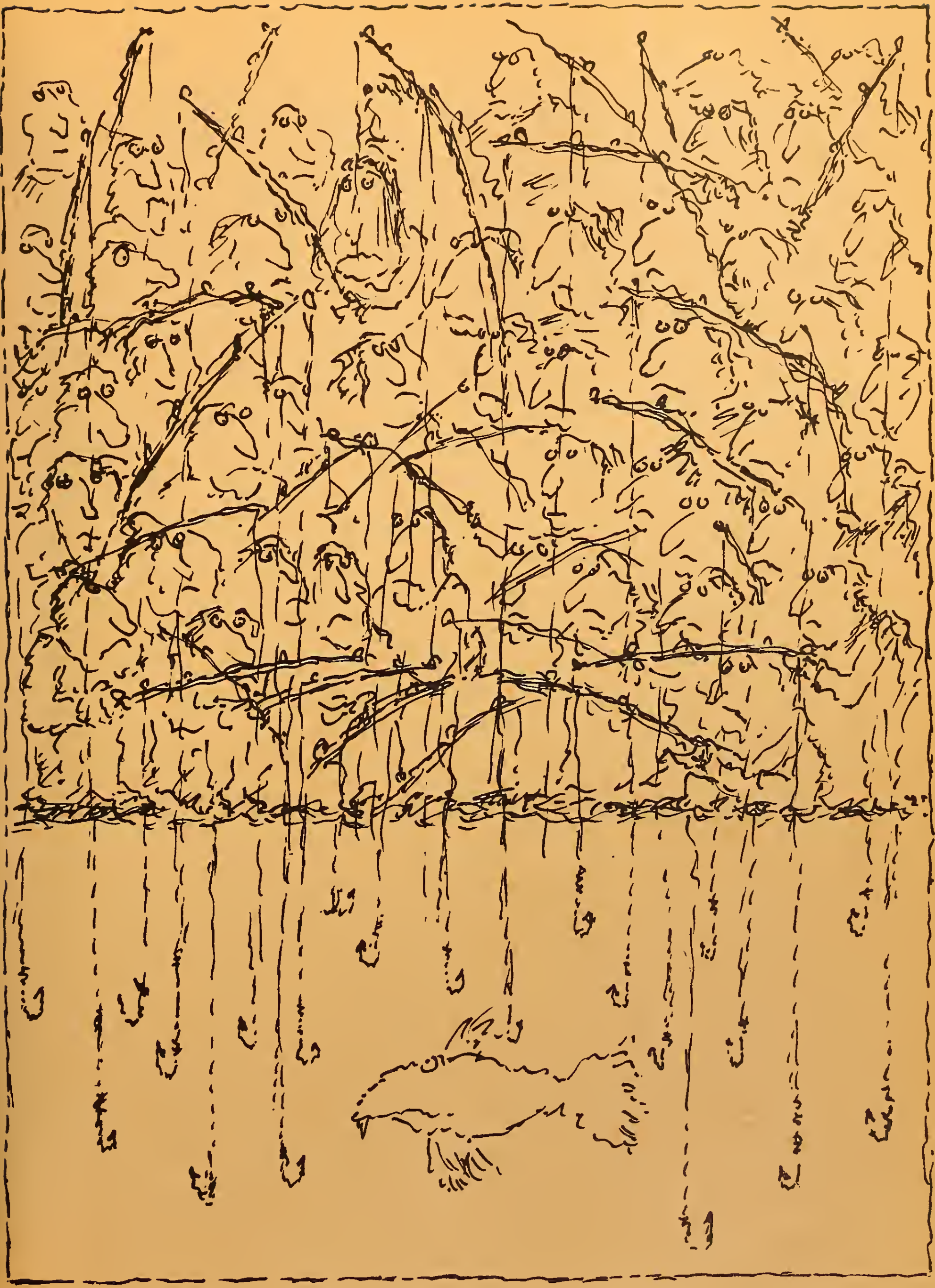
We are just beginning to perceive the limits of our ability to continue endlessly expanding the sum of goods and services for potential distribution to the entire human race. It is possible that we are entering a period of fundamentally different relationships—one in which rising levels of certain types of production and consumption in the affluent societies, rather than benefiting the poorer societies, will be achieved only at their expense. Outer limits of available resources are already being confronted.

The potentially total arable land in the world is estimated at 7.86 billion acres. Only 44 percent, or some 3.43 billion acres, is presently under cultivation; the remaining 56 percent represents areas of degraded soil and virgin land. But these statistics are deceptive. In a number of important areas practically all accessible arable land is already being cultivated. In other areas with a potential for expansion, development is severely constrained by high costs, inadequate or overly expensive technologies, and an unfavorable climate.

Until the middle of this century, world agricultural development was associated with the expansion of cultivated land; since then it has been dependent largely on the intensified exploitation of existing cultivated areas. But the technologies of the Green Revolution, such as extensive use of agrochemicals and increased dependence on improved breeds, that made this exploitation possible have given rise to adverse side effects. These include soil pollution and the disruption of soil-seated biological processes. They cannot fail to point up possible constraints for the future. At the same time, millions of acres of once productive soil are turned into desert each year, their fragile ecosystems destroyed by increased human pressure and ecologically unsound development practices. Man may have already transformed as much as 10 percent of all ice-free lands into desert and reduced global vegetation by one-third.

In many areas we may be even closer to the outer limits of available freshwater supplies than of arable land. Fossil underground waters are nonrenewable resources. Their depletion is apparent in many parts of the world. In other regions renewable supplies are being drawn upon more rapidly than they can be replenished by the natural system. Those of the world's river systems that are suitable for irrigation are currently being used for this purpose, often without regard for a dropping water level. Desalinization of seawater to make up the deficit remains uneconomic in most places and energy-intensive everywhere. Almost every country in the world has some kind of freshwater supply problem. There is, accordingly, a universal need for inexpensive and simple water purification and processing technologies.

On the energy front, an inventory of existing and potential resources is clouded over by ignorance and technical disagreement. We know that we will remain overwhelmingly dependent on fossil fuels until at least the end of the century. By



that time the world's oil and natural gas reserves may be close to exhaustion and will almost certainly be inadequate to maintain our present dependence on them as an energy source.

Nuclear power is the principal alternative currently available; its use will probably spread rapidly. At present, approximately 4 percent of the energy required by the United States is supplied by nuclear power. This figure is expected to increase to perhaps 60 percent by the year 2000, when as many as 1,000 nuclear plants may be in operation. One drawback, however, is that current solutions to the problem of disposing of radioactive wastes, which can carry a half-life of centuries, have not yet been adequately tested under operating conditions. Other possible sources of power—such as solar energy; geothermal, tidal, and wind energy; or the combustion of garbage—exist. But in our present state of knowledge, all of them raise as yet unresolved questions, touching on scientific, technological, economic, safety, and environmental problems.

Constraints on energy use, which creep closer every day, may be due to any of several causes. They may result from conflicts over access to the unevenly distributed world reserves of fossil fuels. They may be imposed by reaching the outer limits of those resources. They may be applied because heat produced in the process of energy conversion has a negative impact on global climatic systems. They might arise from concern over excessive environmental degradation.

Whatever the combination of means used to increase available energy supplies, it will inevitably be accompanied by significantly higher energy costs. These, in turn, will also act as a constraint, providing incentives for a less wasteful use of energy. Prices have already risen dramatically and shortages have already appeared in the most affluent societies. The days of treating energy as a virtually "free" commodity are vanishing. We must, accordingly, develop both industrial technològies and personal life-styles that are less energy-intensive.

The capacity of the world to expand indefinitely its supplies of food has been a point of hard debate for more than a century. For the foreseeable future the potential for food production will continue to be closely linked to supplies of soil, water, and energy, all of which involve the difficulties already touched on. Food production depends on climate and the capacity of natural atmospheric and hydrologic systems to

bear the impact of man's polluting activities. It is also closely linked to population growth. Thus, simply to feed—at existing, inadequate levels of nutrition—a world population that will have doubled by the end of the century, it will be necessary to more than double the present total world food production, a difficult task indeed. Since much of the potential for increased production exists in areas such as North America and Australia, rather than in areas of high population density and growth, it will be even more difficult to insure that those who need the food will have access to it. Without a mammoth and rapid mobilization of resources, successful efforts to stabilize population growth, and the redirection of priorities by the nations of the world on a scale not yet in evidence, we will not succeed in increasing food production to meet even the minimum needs of a doubled population. There is a real prospect that well before the end of the century, possibly in the very near future, millions of people will face starvation.

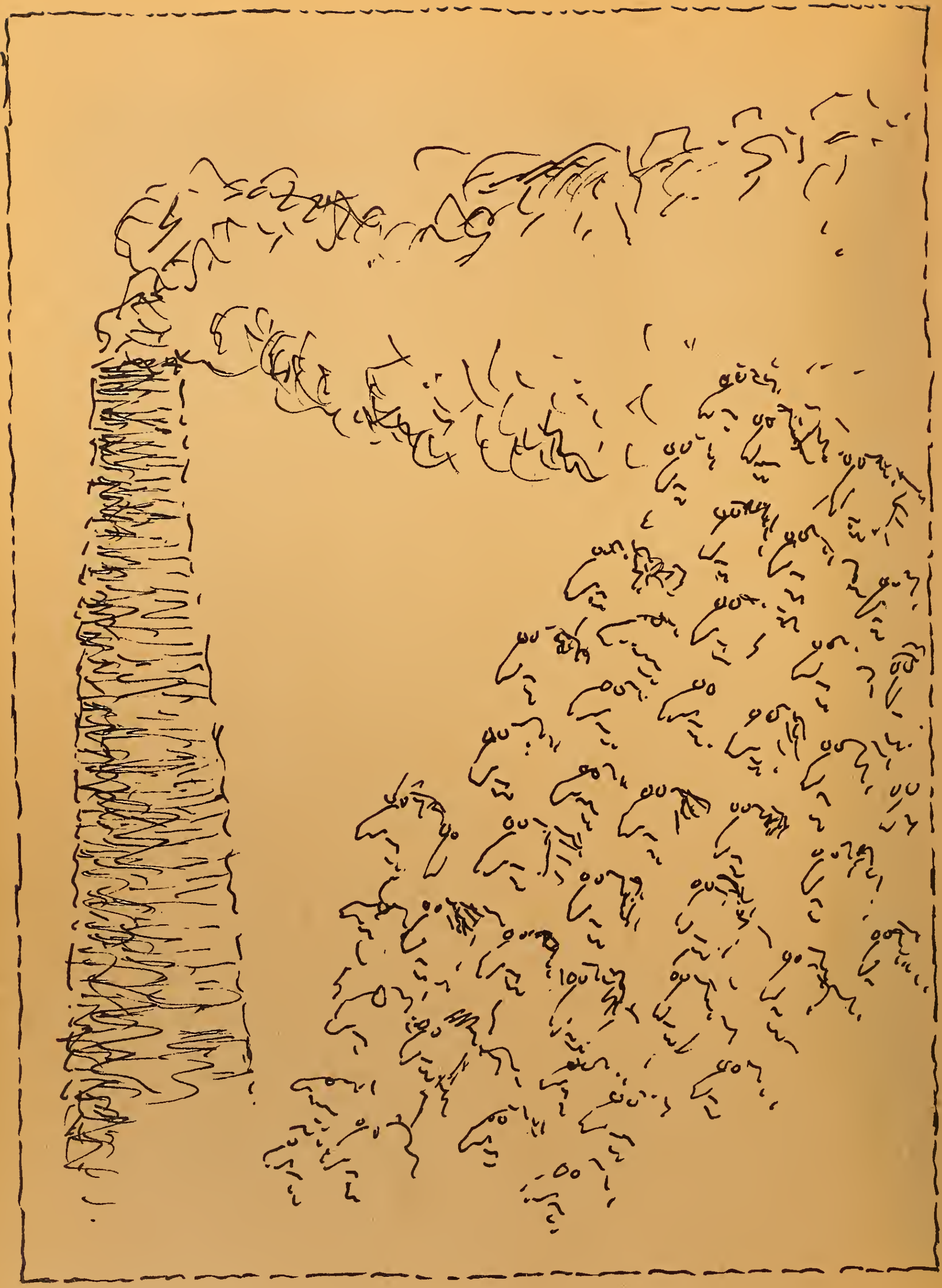
Another kind of restraint looming over us is a set of outer limits on the capacity of the earth's natural systems to withstand the impacts of certain human activities without unacceptable damage to the biosphere or to man himself. We are only now beginning to look seriously at some of these questions and there is still a dangerous level of ignorance about them. We know that some human activities have reached scales that are having deleterious effects on ecological systems. We are beginning to learn that some types of environmental effects can be irreparable and irreversible, and that in some systems, such as the climate, there are thresholds at which incremental impacts may "trigger" highly disproportionate damage.

The climate is an extremely complex, nonlinear system of interacting components—air, water, ice, land, solar energy, and life. The interaction of geophysical climatic processes and life could impose outer limits on human activities with major social and economic impacts over large regions. Learning to predict these outer limits, rather than merely understanding them empirically, will require sound theories of climate and its variations over periods of time.

Climate is constantly varying on many time scales, and it may be difficult or impossible to distinguish natural from human-induced fluctuations. The profound importance of these fluctuations for many natural processes and for such activities as food production has recently focused attention on mechanisms of climatic change and on the possible climatic implications of human activities. The release of heat or combustion products, the alteration of river flows and water evaporation patterns, and the modification of ground cover and surface optical properties can affect climate. Reports given at the 1972 United Nations Conference on the Human Environment and research done since then support the conclusion that climate can undergo rapid transitions, even on a worldwide scale, and that such transitions can be triggered by relatively small perturbations of such sensitive components as the arctic ice pack. Changes may either offset or reinforce each other. Some can produce global instability; others, regional instability. The short-term variations, which are chiefly regional, pose immediate threats to world food production.

Some scientists believe that we may have already entered the beginning stages of a major shift in the dynamics of the earth's climatic system. They point to aberrations in the average rainfall of certain regions, often lasting for several successive years. In northeast Brazil, for instance, average rainfall throughout the 1950s was only about half the normal precipitation. And the sub-Saharan zone of Africa is currently suffering a tragic five-year drought. At the other extreme, the rainy season of 1961 to 1962 in Kenya brought 400 percent more rainfall than normal, and in Tanzania and Uganda the increase was more than 200 percent. During September and October of 1969 the rainfall in northern Tunisia was more than 700 percent of normal, causing floods unprecedented since Roman times.

It is clear that a sound theory of climate and a better understanding of the behavior of the air-ice-water-land geophysical system are major needs of environmental science. They will require a higher commitment of intellectual resources by geographers, geologists, meteorologists, oceanographers, and biologists. Also needed are



expansion of world observational and data-processing systems, an increased flow of capital and manpower, and a closer meeting of the minds between biologists and meteorologists. Understanding and dealing with man's impact on climate is no longer simply an issue for the distant future. Action is needed now. We must be able to foresee the consequences of our deeds before it is too late to remedy them.

In another area—pollution by toxic substances—we face a vast deficiency in existing knowledge. Through our science and technology we have learned to make synthetic compounds that do not exist in nature, for example, pesticides and herbicides. More than a thousand man-made chemical substances are devised each year. Some of these are highly stable and therefore persistent; once they enter the ecological system, they remain undegraded for a very long time. We often do not know how these substances accumulate in the atmosphere, in water, and in food chains, or whether they will combine with each other to form still other and perhaps more hazardous substances. All we know is that we are making some extremely toxic compounds, which should either be banned outright or brought under strict control. And, further, we are using many other substances in increasing quantities without knowing their impact on human physiology or on supporting ecosystems.

The long-term hazards of many man-made substances have not been adequately assessed. Predicting their effect in time to regulate their manufacture or use is therefore a formidable problem requiring the involvement of substantial resources, as well as greatly improved screening and analytical techniques. Since the distribution of a new compound could permanently expose the biosphere to its effects, suspect substances must be identified. Some presumptively dangerous substances can be identified by structural analogy. Others will be detected only through application of the methodology of a wide array of scientific specialties—histology, cytology, and molecular biology.

Even if the primary effects of individual man-made substances become more predictable, it does not seem likely that the effect of several substances in random combinations—whether synergistic or antagonistic—will become predictable in the foreseeable future. The difficulty of anticipating all such interactions raises an important ethical question about trade-offs between the risks and benefits of new substances and where the burden of proving risk lies. Current techniques for detecting potential hazards of man-made substances and for tracing or predicting their environmental pathways can be significantly refined. Nevertheless, even our present, limited knowledge is sufficient to compel the study of whether to stop the production of substances whose risks may be greater than their potential benefits.

To facilitate such studies, the United Nations Environment Program plans to create an international register of toxic chemicals, listing their properties, levels of production, uses, effects, and known or presumed environmental pathways. These data would be continually revised in consultation with cooperating national centers and such international bodies as the World Health Organization.

The oceans play a key role in the preservation of the globe as a habitat for humans and other creatures. It has become increasingly evident that the global balance of carbon dioxide, water, and water vapor—and thus the quality of climate as well as of the very air we breathe—depends in large part on the oceans and the life within them. In addition, we have become ever more dependent on the life in the sea to supply an important share of the protein we eat. Yet marine pollution is mounting because of increasing tanker transport of petroleum products and, most important, because of the introduction through the atmosphere and river runoffs of alien substances derived from man's activities on the land. The prospect of mineral extraction, both liquid and solid, on and beneath the ocean floor, poses still another threat. All these factors have led to concern that we may be on the way to forcing the oceans to bear an impossible burden as the final global reservoir of waste. This anxiety is reinforced by persistent reports of petroleum products and nonbiodegradable materials found even far out at sea, fouled beaches along many shores, outbreaks of disease apparently connected with eating polluted seafood, and drastic changes in the catch of certain fish. These problems are most acute in the case of enclosed and semi-enclosed seas such as the Mediterranean, the Baltic, and the Persian Gulf.

The United Nations Environment Program plans to play a role in assessing and dealing with these concerns. Important components of the program will be cooperation with national governments in the monitoring of pollutants entering the oceans through river outflows and the establishment of a registry of clean rivers. Over a period of time these activities, combined with the monitoring of the atmosphere, will give us a better chance not only to assess the state of the oceans but also to predict whether measures designed for improvement are likely to have the desired effect.

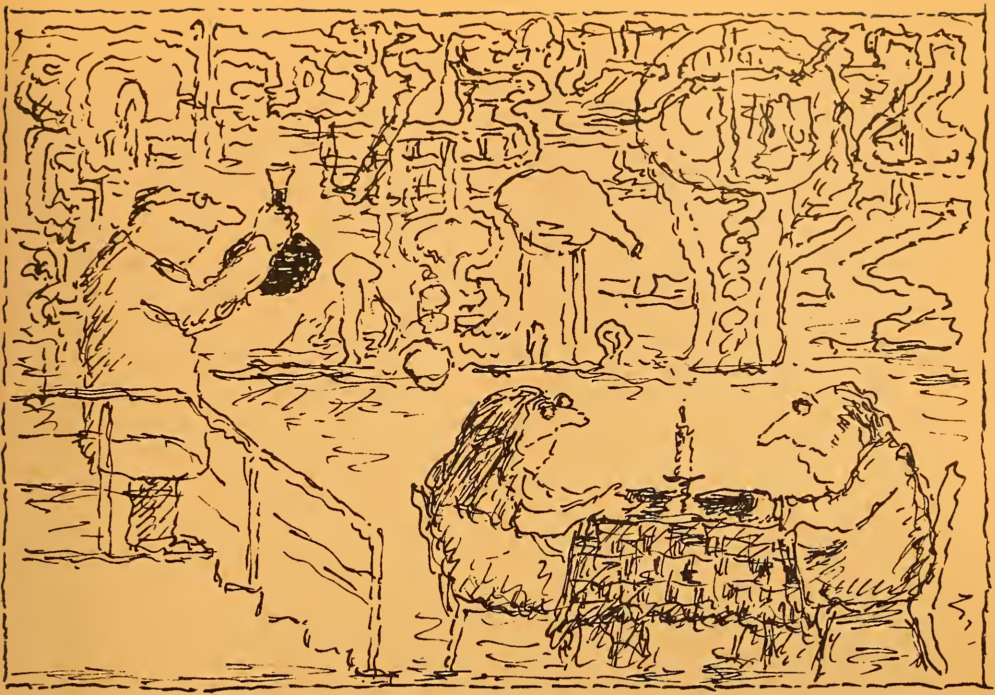
The environmental restraints outlined above may in the next few decades limit the world's production of wealth in the face of both growing population and expanding levels of per capita consumption. There is room, of course, for argument as to how severe some of these restraints may be, exactly what their effects will be, and even whether some of them will turn out to be long-term or only transitory phenomena. But it must be pointed out that in the case of food and energy—the two most critical world resources—there has been a significant shift from a buyer's to a seller's market, accompanied by dramatic inflation in world prices. Sharp shifts have taken place in world trade patterns. And increasing competition for access to supplies has an alarming potential for international conflict.

We may discover and bring into major use new sources of environmentally acceptable energy supplies that do not depend on fossil fuels—but that will not happen within the next few decades. We may discover major new sources of protein foods or better ways to grow them—but these solutions are not now in sight. We may bring population growth under control—but probably not before there are almost twice as many people on earth as there are today. Meanwhile, the headlong pace of mass migration from rural areas to cities, the rapid growth in unemployment, and the escalating pressures on already overstrained resources and services, especially in the developing world, will almost surely get worse before they get better. We are rapidly moving into an era in which more persons will live in the cities than in the countryside, and this migration signals a fateful transition to an entirely different kind of world. By the year 2000, two-thirds of the world's total urban population will reside in the developing nations, where the prospects of large-scale social breakdown and disease are real and imminent.

A former United States secretary of state was widely criticized for his geopolitical "brinkmanship." Some of the current debate on the likelihood of environmental disaster suggests that the whole world is playing brinkmanship with the systems of nature in the belief that somehow, at the last moment, we will stop at the edge of the precipice. Even if this course were a good idea—which it obviously isn't—we would not be able to stop in time. There are too many facets in the interaction between man and nature, between our technological society and the biosphere. It is not, however, the single climactic global disaster in which everything, everywhere, simultaneously falls apart that we have to fear most. What we face in dealing with the environment is a series of problems that will become regional crises at different times and places if we do not act quickly enough, and that could escalate into disasters of sufficient magnitude to have political and moral implications for the whole world community if we do not act at all. The key question is thus, not whether planet Earth will survive, but whether it will remain fit for human habitation.

The human impact on the physical elements of the biosphere stems entirely from man's economic and social behavior. Our increasing awareness of physical constraints is therefore reflected first in accelerating pressures on our political and social systems, on the values and behavior patterns those systems reflect, and on the institutions through which we seek to manage our affairs.

Our institutional structures at all levels of government are already showing signs of severe strain. National governments seem to be increasingly overwhelmed by the sheer magnitude and complexity of unprecedented problems in



decision making brought on by the cumulative and interacting effects of population growth, industrialization, urbanization, resource depletion, environmental degradation, and unrestrained consumerism. Qualitatively new problems of choice seem to lead to a hardening of the arteries in traditional decision-making procedures that threatens to result in institutional paralysis. There may be a blind insistence on continuing to deal with issues rendered obsolete by the course of events or, alternatively, panic may set in and lead to overreaction and the initiation of crash programs all too likely to be technically wrong or politically repugnant or both.

The United States is an example of the lack of long-range planning followed by what some might regard as near panic. In a forty-year period the country has moved from being the world's leading exporter of petroleum to its leading importer, and is beginning to reshape its attitudes and policies only in the face of the current energy crisis. The same response is apparent in the country's rapid transition from a philosophy based on an abundance of food grains, with its accompanying emphasis on exports, to a philosophy of scarcity and export restrictions. Both the energy crisis and the food crisis were eminently foreseeable—although they were clearly not foreseen by decision-makers at the highest political levels.

At the level of the world community, the international structure is no better equipped to deal with today's overriding issues. These are no longer national matters of security, ideology, the deployment of arms, or the competitive pursuit of illusory advantages for the prestige of individual states. The self-interests of all nations today are inevitably interwoven in a web of interdependencies characteristic of our present technological civilization. This reality requires a cooperative approach to the management of the interacting relationship between the development and distribution of resources, the minimal needs for sustaining decent standards of human life, and the protection of the environment on which that life depends. These interlocking concerns must be moved to the top of the world's agenda for thought and action. They are ultimately inseparable from the issues of war, peace, and national security that have preoccupied us up to now. The potential for conflict in such issues as competition for resources, lopsided deployment of technological power, pursuit by nations of activities environmentally harmful to others, and unequal pressures created by population growth is as great as the incentives they provide for cooperative measures to deal with them.

It is still possible to avoid the worst implications of the limits of our resources and the strain on our environment, but we need time to gain some measure of control over those human activities that are at odds with a viable natural system. We need time to adapt scientific and technological priorities to the imperatives of contemporary life; time to reform institutional structures and life-styles. Unless there is strong, rapid, even radical action now, we may be headed for disasters almost too dreadful to contemplate. For if we fail to act decisively, we shall surely slip into a pattern of decisions and nondecisions, actions and nonactions, whose outcome will determine which individuals and which nations will survive and which will not. If we respond only to immediate pressures, fail to plan ahead, and compete instead of cooperate, we will break the bonds of interdependence and revert blindly to nationalism, protectionism, and parochialism. The fabric of world community, so painfully constructed, would begin to disintegrate into pockets of affluence and privilege struggling to resist the encroachment of a mounting tide of poverty and despair. Some collapse of the social order would probably take place well before the world reached the theoretical physical outer limits of its finite natural system.

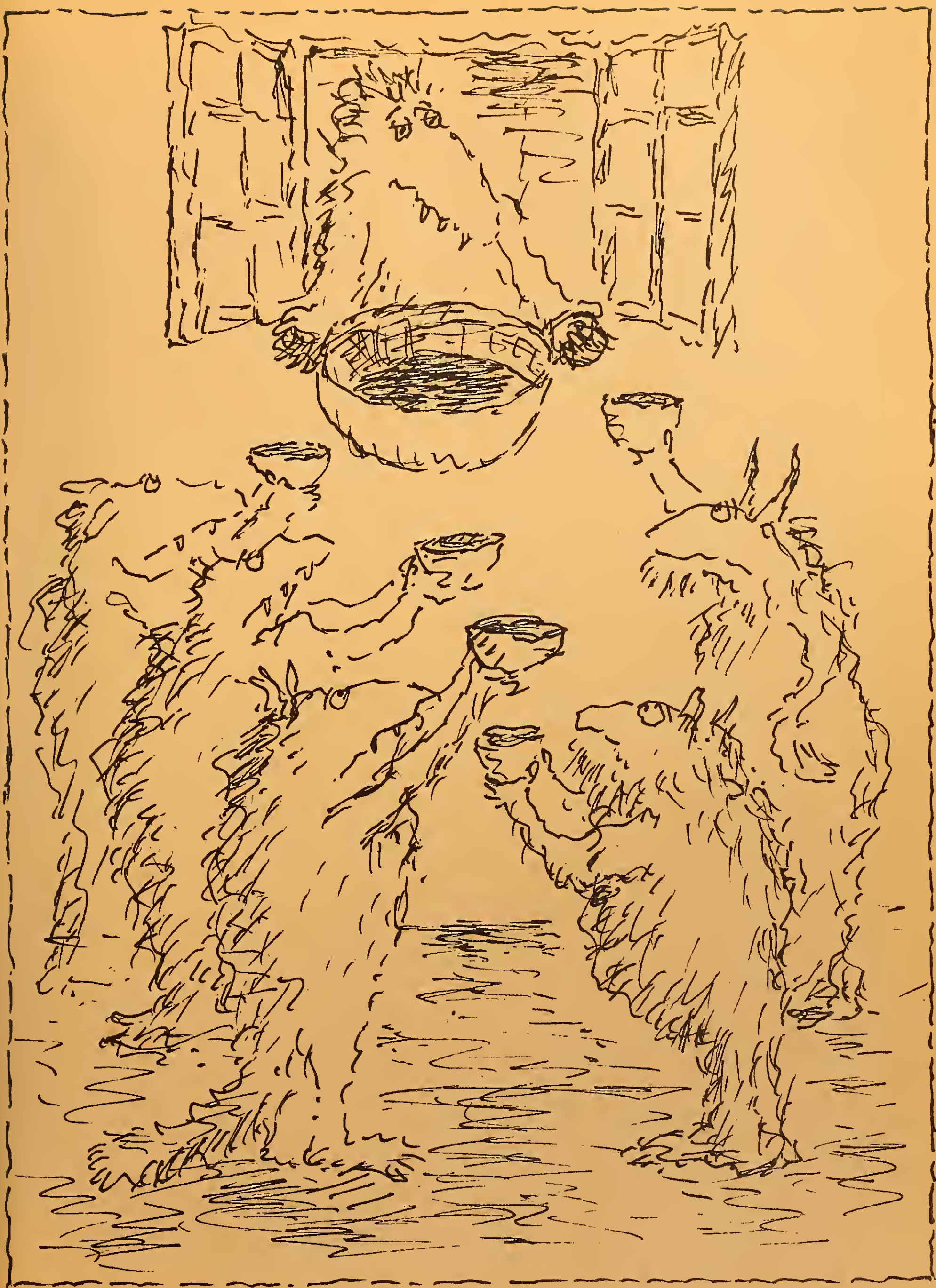
In the face of potentially serious breakdowns in specific geographic areas, with tragic consequences for large numbers of people, the ad hoc responses that have characterized our reactions to these environmental emergencies in the past can no longer be tolerated. In our own self-interest we should consider the creation of disaster-prevention programs on a global scale. Just as schools have fire drills and ships have lifeboat drills, spaceship Earth needs emergency survival systems.

We must evolve a strategy for global environmental security—a planetary policy to avoid disaster and provide a greater sense of direction in human affairs. Such a policy could be built around six basic elements.

First, population must be stabilized. This can probably be achieved most rapidly in the industrialized countries, since they are already moving in that direction. The goal will be more difficult to achieve in the developing countries, where population growth is greatest and the new demands it creates on resources are most difficult to satisfy. Some of these countries are already facing the prospect of population limitation through the procrustean means of famine and disease; such forbidding prospects will undoubtedly accelerate if efforts to limit population in more humane ways prove too little or too late. Population control can only be brought about by making improved techniques of family planning universally available and by providing incentives for the reduction of family size largely through a rise in the standard of living.

In an era when national borders are closed to large-scale immigration, the population growth of each country is first and foremost a matter of its own concern. Thus, the first task of the international community should be to help all nations evaluate the trade-offs that only they can make between population growth and distribution, available resources, and desired standards of living. The population levels of individual nations become a world concern only when they begin to impinge on the resources and rights of other states. This is already happening in some instances and is clearly going to take place in others. To say that population is primarily a national responsibility does not relieve us of the need to see it also as a global concern.

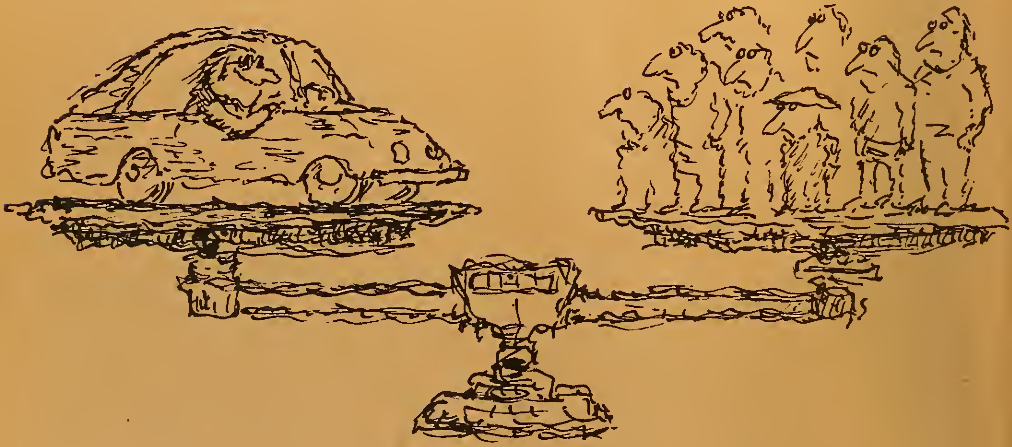
Second, there must be a worldwide program to conserve scarce resources. The ethic of limitless abundance must give way to the ethics of scarcity and conservation. A rise in the cost of natural resources will provide incentives for the development of more efficient methods of using and reusing materials. Greater emphasis must be placed on the development of technologies and patterns of consumption that are less energy-intensive than those presently in use, on closed-system production methods, and on techniques for recycling. Higher resource costs may also result in differential price structures with lower prices for raw materials used to sustain life and higher



prices on those employed for less essential purposes. Reserve stocks of vital resources should be maintained in quantities sufficient to meet foreseeable emergencies. This should be done under international control—as the United Nations Food and Agriculture Organization is currently proposing in respect to stocks of food.

Third, new models for economic and social progress should be elaborated and adopted. In the industrial world, this would involve life-styles oriented to nonmaterial satisfactions and changes in patterns of consumption from quantity to quality. It would require new criteria for decision making that would assign appropriate values to social factors, to amenities, and to the preservation of such public resources as water and air. In the developing world new directions for growth should be designed to avoid the errors and excesses made by already industrialized countries. Progress should focus on labor-intensive activities and the sound ecological development of indigenous resources, with particular emphasis given to rural areas. The need to avoid overburdening the environment in any particular region would motivate a wider distribution of industrial capacity, both within nations and internationally, than has been past practice. Environmental considerations also provide new reasons to seek less wasteful uses for natural products and a more equitable, international division of labor. These precepts, together with the growing demand for natural resources, could produce a significant shift of comparative economic advantage toward the developing countries. That should be encouraged despite the transitional problems such a readjustment would create in more industrialized parts of the world.

Fourth, there must be a much larger flow of resources between rich and poor countries, with heavy emphasis on providing basic social services to the poorest sectors. This policy should be seen, not as charity, but as a prerequisite for the basic economic and social security that is essential to the health and stability of a functioning world community. Programs of direct foreign aid between individual nations must give way to more objective and automatic means of transferring resources. For example, a disproportionate share



of the Special Drawing Rights created by the International Monetary Fund might be made available to developing countries. They might also be assisted by a toll on the use of the oceans and the atmosphere for transport and waste disposal. In effect, we must extend into international life the same principles of distributive justice and minimum opportunities for all that are accepted as the basis for relations between rich and poor in our national societies.

Fifth, science and technology must be mobilized on a worldwide scale to reduce our ignorance about environment, resources, and population, and to help devise new ways of improving the human condition. This effort will involve a large-scale redirection of research and development expenditures and the reorientation of the priorities of science and technology. It will involve reshaping the policies of industrial corporations, the leading practitioners of the world's technology, to assure that they are compatible with the social goals of society.

A more effective relationship must also be developed between scientists and technologists on one hand and political decision-makers on the other. Specifically, the scientific community must provide the politicians with environmental advice on risks and opportunities before they make decisions that will shape our future. The Earth Watch monitoring system now being set up as part of the United Nations Environment Program is designed to help meet this need. When fully functioning, it will provide an objective assessment of the condition of the environment and give early warning of impending risks.

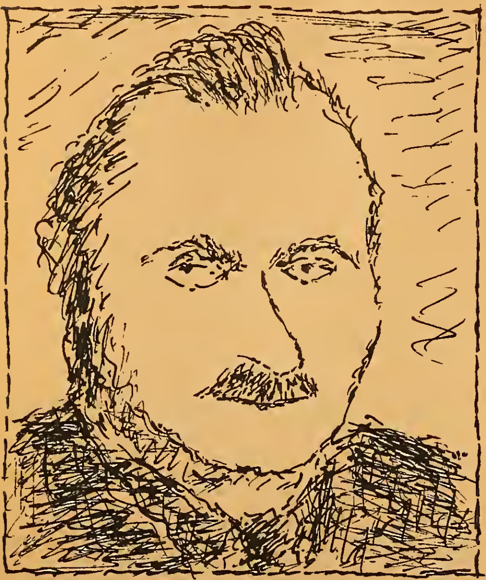
Sixth, the resources of the oceans beyond national jurisdictions must be put under international control to assure that the principal beneficiaries of their exploitation are those living in the developing world. This great new source of wealth must not become the object of fierce competition among the wealthy countries having the technology to exploit it, or the basis of a new imperialism in which the wealthy gain a disproportionate share of the benefits at the expense of the poor. Even before exploitation begins, all nations should agree that the a priori consideration must be the preservation of the marine environment and its vital, life-sustaining processes. Many of these issues will be discussed at the forthcoming United Nations Conference on the Law of the Sea.

Seventy percent of the earth's surface is ocean beyond national jurisdictions. Bringing this vast expanse under the rule of law is one of the greatest challenges facing this generation. The way we meet that challenge will largely determine the future of rich-poor relations on this planet.

It is evident that the measures suggested here require new dimensions of international cooperation and an expanding role for the organizations through which this cooperation must be carried out. Much of the program could, of course, be accomplished through bilateral and regional arrangements but even these must, to an increasing extent, take place within a larger global framework. Such a "new internationalism" is not a utopian dream but an objective necessity—and one that is well within our reach. But to achieve it, the community of nations, particularly the countries of the industrialized world, will have to exercise a much greater degree of enlightened political wisdom than they have yet evidenced.

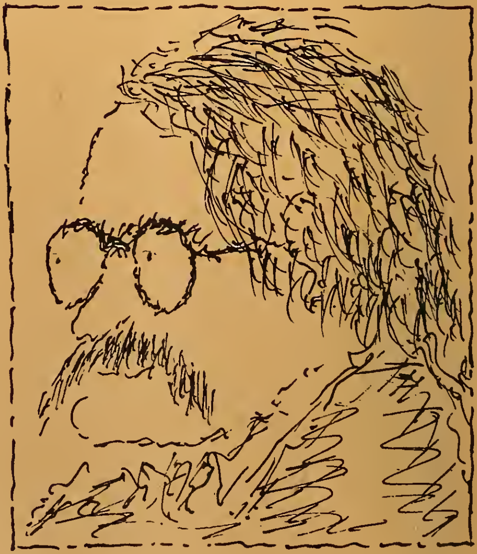
In the final analysis, nations will have to recognize that there can be no basic or enduring conflict between their national interests and the interests of the whole human community. The same compelling pressures of broader self-interest that induced man to form ever larger social and political units—first the family, then the tribe, the village, the town, the city, the city-state, and finally the nation-state—must inevitably impel mankind toward a planetary society. Loyalty to this planetary society will modify but need not negate an individual's loyalty to his nation, any more than loyalty to the nation negates loyalty to the family, the tribe, or the city.

The environment issue has helped make us aware that we do indeed have only "One Earth" and that all humans share both its dangers and its possibilities. Perhaps this awareness will help give birth to a new sense of loyalty to the planetary society. If so, environmental awareness may be the key to a new internationalism that will enable the whole human community to realize the promise offered by technological society.



This essay is adapted from the Fairfield Osborn Memorial Lecture delivered recently at The Rockefeller University by Maurice F. Strong. These annual lectures are sponsored jointly by the New York Zoological Society, the Conservation Foundation, and the University. Strong was born in the small prairie town of Oak Lake, Manitoba, but considers himself primarily a citizen of the world rather than a Canadian. He is currently executive director of the United Nations Environment Program, an outgrowth of the 1972 U.N. Conference on the Human Environment, which he organized. Before coming to the United Nations, Strong directed the foreign aid program of the Canadian government.

A native of New York City, Edward Koren is best known for his cartoons, which have appeared regularly in *The New Yorker* Magazine for the past ten years. When not cartooning, Koren teaches art at Brown University in Providence, Rhode Island. He is a graduate of Columbia University and studied in Paris and at Pratt Institute in New York. He was awarded a Guggenheim fellowship in 1969, one of the few cartoonists to be so honored.

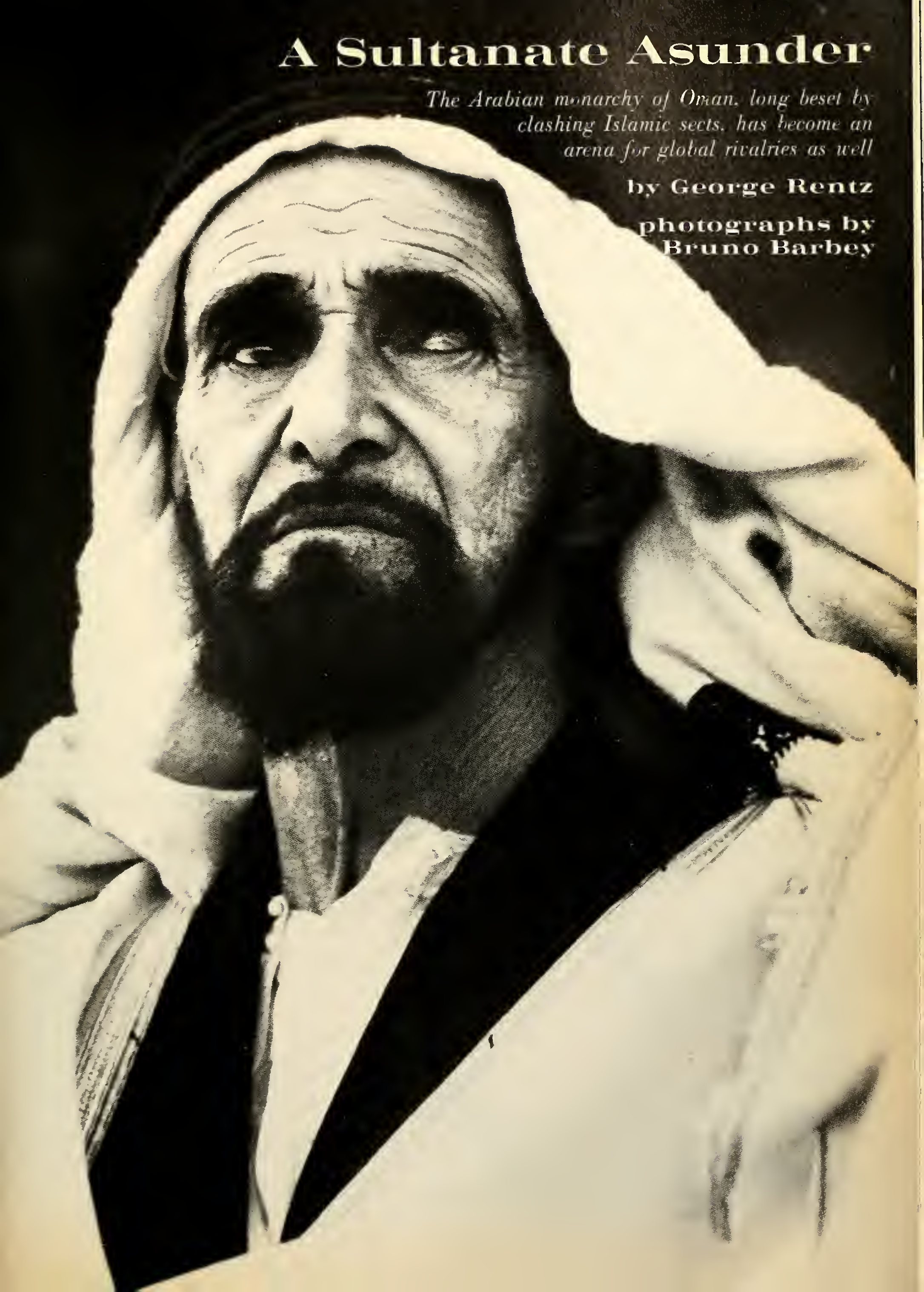


A Sultanate Asunder

The Arabian monarchy of Oman, long beset by clashing Islamic sects, has become an arena for global rivalries as well

by George Rentz

photographs by Bruno Barbey



Until recently the sultanate of Oman was the most secluded and least known country in the Arabian Peninsula. Now, with the discovery of oil within its borders and with world attention focused on the Middle East, Oman is emerging from its isolation. The same, however, is not as true for the Ibadites, an Islamic sect whose members make up a large part of Oman's population and shape much of its religious and social life. Throughout the Islamic world, which stretches over broad areas of Asia, Africa, and Europe, the Ibadites are regarded as an indrawn and mysterious people.

The smallest of the three Islamic sects, the Ibadites number no more than half a million followers, while the other two sects—the Sunnites and the Shiites—together number perhaps half a billion. The antecedents of Ibadism go back to the first century of Islam (the seventh century A.D.), when a band of extremely strict Muslims accused Ali, the head of the Islamic community, of deviating from the fundamental principles of the new faith. Even though he was the son-in-law of the Prophet Muhammad, they left his camp, earning themselves the designation of Kharijites ("outgoers" or "seceders").

This secession took place in Iraq, Ali having moved the capital of Islam there from Medina. The partisans of Ali, the future Shiites, then lost out in a conflict with other rivals, the future Sunnites, who founded the first Islamic dynasty, with Damascus as capital. The dissident Kharijites energetically resisted Sunnite rule, particularly in the Arabian Peninsula. In time, however, they split into divergent branches, of which only the Ibadites have survived. The name Ibadite is taken from Abdallah ibn Ibad, an Arab theologian who is regarded as the founder of the branch.

A basic cleavage between the three sects is the question of who should head the Islamic community as successor to the Prophet. The Shiites require that the head, whom they term imam, be a direct descendant of the Prophet through his daughter Fatima and her husband, Ali. The Sunnites, allowing greater latitude, stipulate that the head, whom they term caliph, must be a member of the Prophet's tribe, the Quraish (Koreish). The Ibadites, however, maintain that any Muslim, provided he meets the prescribed standards of character, piety, and leadership, can be chosen as imam—"even an Abyssinian slave whose nose has been cut off" (none, however, has yet been elected by them).

While the Sunnites and the Shiites have leaned toward dynastic succession, the Ibadites adhere to the original Islamic principle of election. Choosing a new imam is the prerogative of "the people who bind and loose," the influential members of the community whose choice the common people should ratify by acclamation. Ibadite doctrine also holds that if there is no qualified candidate, an interregnum in the imamate is acceptable.

To escape the long arm of the Sunnite caliph, many of the early Ibadites migrated from Iraq and settled in Oman on the eastern edge of the Arabian Peninsula. From there missionaries and merchants carried Ibadism down to the coast of East Africa and the offshore islands, especially Zanzibar. Other Ibadites moved westward and created isolated centers in North Africa, where their antiauthoritarianism appealed to Berbers restless under the rule of Arab conquerors. Small Ibadite groups, following their traditional beliefs, still live in the mountains of Libya, on the island of Jarbah off the Tunisian coast (sometimes identified with Ulysses' Land of the Lotus Eaters), and in oases along the northern fringe of the Algerian Sahara. Scattered as these eastern and western Ibadite settlements are, they have maintained contact with each other over the centuries.

Oman is the largest and most significant Ibadite refuge and stronghold. There a rugged mountain range, traversed by only a few difficult passes, seals the interior from the coast. Some Ibadites live on the seaward side of the range, but the main body of believers is found in inner Oman, where water brought down from the mountains by underground, Persian-type aqueducts irrigates fertile plantations of dates and other crops. Here the Ibadites have pursued their way of life with little or no contamination by detested alien influences.

The supreme goal of Ibadism is the establishment and maintenance of an Islamic society modeled after the original Islamic community of the Prophet Muhammad. Accordingly, such a community should be ruled by the prescriptions of the Koran, the divine revelations transmitted through the Prophet, and guided by the examples provided by the Prophet's own words and acts. This has not always been easy to achieve. For centuries before Islam, Arab tribes were embroiled in bitter rivalries, such as the one between the southern and the northern Arabs. Islam's revolutionary doctrine that piety, not birth or ancestry, is the touchstone of nobility in the sight of Allah only partially undermined the tribesmen's pride in their lineage. Ibadite Islam has had to contend with this same powerful force of tribalism in Oman, where southerners and northerners have frequently been at odds.

Every Ibadite imamate in Oman has also had to contain another age-old and deep-rooted rivalry dividing the Arabs, that between the nomads and the settled people. The larger nomadic tribes range in the interior, where their members often penetrate into the sandy wastes of the Empty Quarter, the great southern desert of Arabia. When peace prevailed, the nomads would trade in the town markets, but time and again the calm was shattered by nomad raids on the town dwellers.

The first Ibadite imam in Oman was elected in the eighth century A.D. Many imams succeeded him, although there were interludes when the community existed without a head. In the second half of the eighteenth century the imamate was bestowed on the ancestor of the present ruling family of Oman, the house of Said. The grandson of this imam, apparently lured by the commercial wealth of the seaports, took the drastic step of transferring his capital to the coastal town of Muscat, where the consequent exposure of the rulers of the house of Said to heretical ideas and practices estranged them from the strict Ibadites of the interior. Although the members of the house remained Ibadites, they could no longer win election to the imamate, their rule lacked religious justification, and they gradually assumed the secular title of sultan, the Arabic word for power.

In Muscat the new sultans developed a close relationship with the British, who, in line with their policy of protecting the main routes to their empire in India, were consolidating a position of dominance in the Persian Gulf and along its approaches. In the first half of the nineteenth century, the reigning sultan, whose gaze turned toward the sea rather than to inland Oman, lifted Muscat to its apogee as a maritime power. Holding Zanzibar and a number of ports on the East African coast, he guarded his possessions with what was then the largest fleet in the Indian Ocean. In 1833 he concluded a treaty of amity and commerce with the United States, the earliest American treaty in that part of the world.

But the sultan's best friend was Britain. A captain of the Royal Navy quoted the sultan as saying that he looked upon the English as brothers, and would willingly give them his country. He did not go that far, but among his gifts were a seventy-four-gun ship and the Kuria Muria Islands off the southern coast of Arabia, then sought for their rich guano deposits. On his death in 1856, two of his sons quarreled over the territories he had left behind, whereupon the British Viceroy of India split Muscat and Zanzibar into separate states.

Only once during the nineteenth century did the Ibadites of Oman succeed in agreeing on a suitable candidate for the imamate. The British, continuing their collaboration with the sultan of Muscat, refused to recognize the choice of the Ibadites, and after only a short reign the imam died in battle against the sultan's forces.

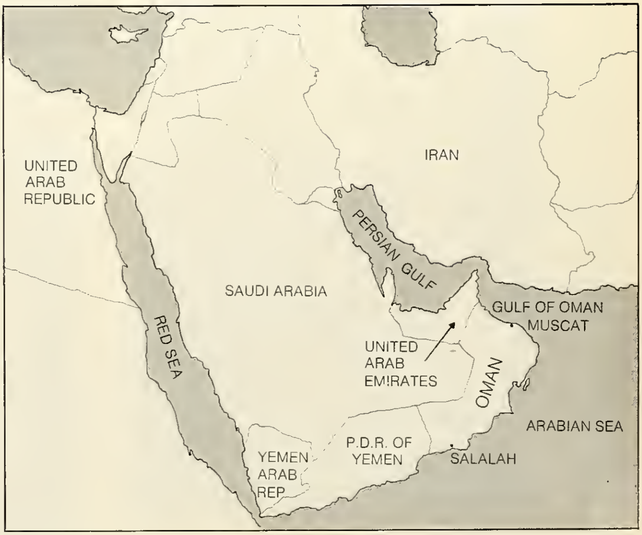
In the early years of the twentieth century the strict Ibadites of the interior grew increasingly disenchanted with the secular government of the sultanate based on the coast. The celebrated British explorer and Arabist Gertrude Bell wrote that the sultans had become "exposed to foreign influences, which alienated from them the sympathies of the tribes in the interior. To these foreign influences, to the reliance of the sultans of Muscat on foreign naval and military power, and to their enforced submission to foreign requirements in the matter of the traffic in slaves and in arms, the modern unrest is due."

Although slavery is now outlawed throughout the Islamic world, half a century ago many conservative Muslims opposed its abolition on the grounds that it was an institution sanctioned by the Koran. The Ibadites of Oman resented the way in which the sultan cooperated with the British in efforts to suppress the slave trade. The same was true with respect to the British campaign to put an end to clandestine gunrunning, which meant cutting off the Ibadites of the interior from the main supply of weapons they might use against the sultan.

Ibadite discontent came to a head in 1913 with the election of a new imam, the first of the twentieth century, in direct opposition to the sultan. Two years later the imam's warriors fought their way into the sultan's capital, Muscat. The British political agent there reported that "the rising assumed a religious character and the imam was preaching a jihad [holy war]." The imamate might well have destroyed the sultanate if the British had not rushed Indian troops to Muscat. The imam's forces were driven back, and the sultanate was able to maintain its authority over the narrow strips along the coasts, while in the interior a second imam was elected following the death of the first.

In 1920, the two sides reached an uneasy accommodation. Among the provisions of their agreement was one whereby the sultan's government agreed not to interfere in the internal affairs of "the people of Oman"; in return, the supporters of the imam promised not to attack the towns on the coast or to interfere in the sultan's government.

The accession of Said ibn Taimur as sultan in 1932 led to sweeping changes in the sultanate. His predecessors, although they professed Ibadite beliefs, had allowed the spread of practices condemned by the adherents of the imamate. In contrast, the new sultan was cast in the same mold as his conservative coreligionists of the interior. He is reported to have wanted to win election as imam, but the old hostility between interior and coast made



the chances of his doing so highly unlikely. Nevertheless, he was determined to impose a type of rule strikingly similar to that of the imamate, and he rigorously enforced his stern decrees throughout his domain. Wine and other intoxicants were not permitted (*khamr,* usually translated as "wine," is forbidden by the Koran). There was to be no smoking ("drinking tobacco," which is the Arabic expression, is abhorrent to conservative Muslims). Singing, dancing, and frivolous music were banned—only martial chants were permitted. Similarly, the cinema and other forms of representational art, with the exception of photographs, were prohibited. Women were consigned to their proper place in a man's world—out of sight.

Sultan Said made every effort to isolate his country and subjects in order to protect them from the temptations and the wickedness that prevailed abroad. He did, however, employ a handful of British officials in key positions in the government and armed forces, and he allowed a few American missionaries to carry on medical work (they had two small hospitals, while the government did not have a single one). A predominantly British oil company was permitted to begin operations, but it was virtually impossible for all other foreigners to obtain entrance visas. Essential commodities came into the country and a modicum of exports went out, but trade was not encouraged despite the sultanate's earlier record as a flourishing center for such activity.

Looking upon schools as breeding places for dangerous ideas, Sultan Said resolutely opposed the expansion of education. By the last year of his reign the government provided three primary schools for boys (none for girls) and one theological institute; in all, there were fewer than a thousand students. The sultan also tried to prevent young men from going abroad to study, and most of those who did so were not permitted to return to their country. The sultan did allow his only son, Qabus, to attend Sandhurst in England, but upon his return, he was denied any voice in the management of the affairs of state.

Along with isolating the country, the sultan isolated himself. Muscat, the old capital, was too open for his taste, but despite his enforcement of the stringent precepts of Ibadism, he was not welcome in the interior; he moved instead to the secluded port of Salalah in the southern province of Dhofar. Once settled there, he would not even visit Muscat. Any citizen in a distant part of the country with business to lay before the sultan had to make the arduous trip to Salalah. In Muscat itself the city gates were locked three hours after sunset, and a cannon shot signaled the beginning of the regular curfew. During curfew no one was allowed out into the streets without a hurricane lamp, which few people owned.

In 1954, the second imam of this century died, and a third was elected in the interior. The live-and-let-live arrangement arrived at by the sultanate and the imamate was breaking down. The imamate—in principle a pure theocracy—was becoming increasingly political, and it tried, fruitlessly, to secure membership and recognition as an independent state in the Arab League. When these two forces, the sultanate and the imamate, engaged in armed conflict, Sultan Said turned to his old friend Britain for help.

After initial successes against the imamate, the sultan, for the first time in his long reign, journeyed into the interior. His trip, however, did not end the war, which dragged on sporadically for another three years and did not end until early 1959. Toward its close the fighting became so severe that a detachment of British troops was brought in to quell the imam's followers. The imam then gave up the struggle and went into exile in Saudi Arabia, which had supported his cause against the sultan.

The friendship, if not actual alliance, that had grown up between the Ibadite imamate of Oman and the Wahhabite kingdom of Saudi Arabia was a remarkable development. The Wahhabite interpretation of Islam prevalent in Saudi Arabia resembles Ibadism in its rigidity and its insistence on a return to the ways of the Prophet and the uncorrupted life of the early Islamic community. The Wahhabites, however, consider themselves Sunnites of a highly orthodox persuasion; as such, they have tended to class the Ibadites as heretics. On a number of occasions in the past, religious differences had set the Wahhabites and the Ibadites against each other, but at this time they joined together against their common enemy, the sultanate.

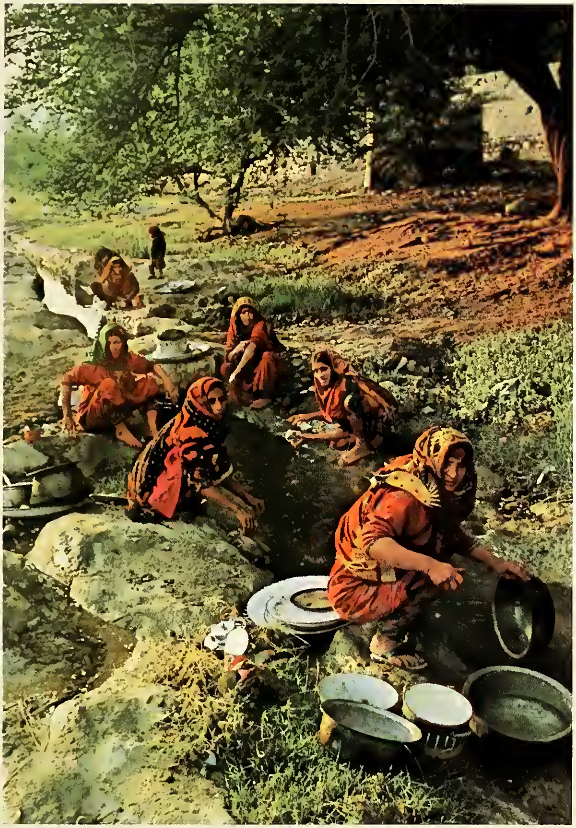
The forging of closer ties with Saudi Arabia helped to enlarge the horizons of more and more young, liberal Omani Ibadites, who were finding the dictates of Sultan Said unacceptably oppressive. Observing what was happening in other Arab states, they determined to bring into power a new regime with a totally different outlook. At their head was the sultan's Sandhurst-trained son, Qabus.

In July, 1970, the liberals struck, deposing Said and banishing him to Britain, where he died in 1972. Qabus, aided by liberal ministers, took his place as sultan in a newly structured government no longer dominated by one man. Attempting to end the historic dualism of the coast and interior, Qabus changed the country's name from the Sultanate of Muscat and Oman to Oman. The building of good roads and other improvements in communications are also drawing the two sections together.

During the past several years, Oman's political, social, and cultural life has changed enormously. Social prohibitions have been lifted, and singing, dancing, and films have become popular diversions.

Continued on page 66

Once a source for everything from fruit to elaborately painted chests, Oman's open-air markets are being replaced by modern shops. A gun vendor, bottom right, is kept busy because nearly every Omani man owns a rifle.



Although the 1970 coup gave Omani women the right to an education, they still lead highly restricted lives filled with such chores as carrying water, bottom, and washing utensils in streams, left. Many still cover their faces in public, but the distinctive masklike veils of Baluchi tribeswomen, below, are rarely seen today. A bride, far left, acquires some of the family jewels when she marries.

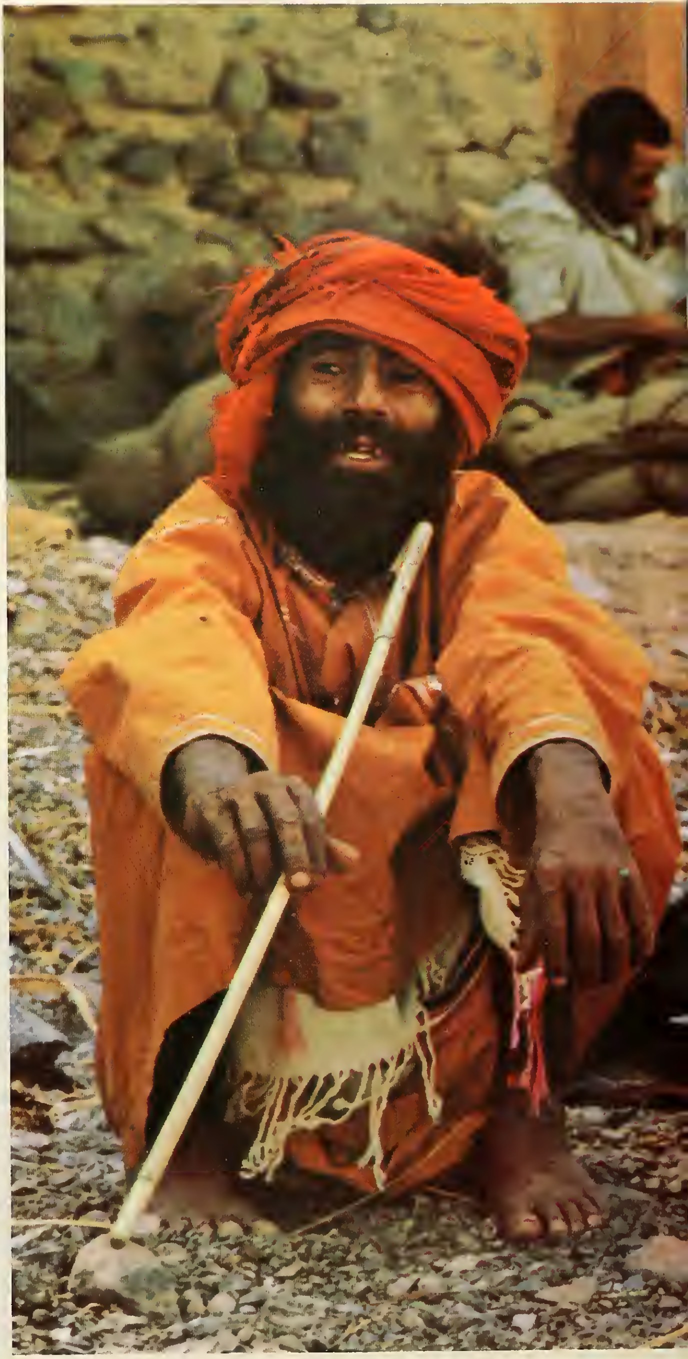
During the thirty-eight-year reign of Said ibn Taimur, which ended in 1970, education and trade were discouraged. Today, imported cars cause traffic jams in Matrah, right, and children, top, attend newly built schools. Above and left: Small groups of men, their ornate khanjars *("daggers") tucked into their cartridge belts or sashes, rest during the heat of the day.*

Continued from page 60

Development is taking place in many areas—agriculture, fishing, oil exploitation, education, and transportation. At the same time, Oman's political profile has been raised, and it has joined the Arab League and the United Nations.

In today's world, it is probably impossible for any country to maintain the isolation and seclusion that for so many years characterized Oman. Like the other Arab states, Oman has become an arena for the playing out of international politics. For the past ten years a group of guerilla fighters, the Popular Front for the Liberation of Oman and the Arabian Gulf, has been holding territory in the mountains of Oman's Dhofar Province. Led by men trained in the People's Republic of China, the Soviet Union, and East Germany, aided by the People's Democratic Republic of Yemen and by Iraq, and fighting with Soviet-made rifles and rockets, the guerillas are trying to bring the entire gulf region under their control. The sultan's effort, in turn, has been supported by Britain, Jordan, Libya, and Iran; Iran is reported to have recently sent in several thousand troops, about thirty helicopter troop carriers, and some artillery.

At present Oman is not only caught in the mesh of international rivalries, it also remains beset by internal divisions. Ibadites and Sunnites, nomads and townspeople, inhabitants of the coast and people of the interior—all have struggled for centuries to maintain their disparate ways of life. Although the sultan is striving to reconcile these different groups, their old traditions will not die easily. ☐



The loose, heavy clothing worn by Bedouin camel drivers keeps them comfortable during the day by absorbing perspiration and allowing air to circulate.

2
2

Running and Jumping

A man's top speed is greater and a cat's leaping prowess is less than are commonly accepted

by David P. Willoughby

There are many misconceptions concerning the speed and agility of animals, especially wild animals. Their actual abilities are difficult to measure, which creates problems when the inevitable comparisons with human performances are made.

Even in humans, it is common for mistakes or underestimations to be made. For example, if a man's fastest running speed is the rate at which he can run 100 yards, the half-dozen sprinters who have covered this distance in 9.1 seconds were running at a rate of 22.48 miles per hour. Actually, when Bob Hayes first set this record in 1963, his top speed was attained between the 60- and 75-yard marks, a 15-yard stretch he covered in only 1.1 seconds. This means that during this distance he was running at a speed of 27.89 miles per hour. Similar analyses should be made of the claimed top speeds of many domestic and wild animals.

In that most familiar of running animals, the racehorse, the speed records are probably as reliable as any such data can be. These records show that in the quarter horse—a breed especially developed for sprinting up to 440 yards—top speed is attained between 75 and 85 yards and reaches a peak of 47.5 miles per hour at 80 yards. Riderless, a quarter horse should be able to attain a top speed of about 50 miles per hour. This stamps the racehorse as one of the fastest of all running animals, surpassed only by certain gazelles, the pronghorn antelope, and the cheetah.

In comparison, the fastest greyhound reaches a top speed of about 39 miles per hour over a 500-yard distance. In a race against a quarter horse, a greyhound would be overtaken about 340 yards from the starting point. (The fastest human sprinter would be left in his tracks as both the horse and the hound sprang away from their starting positions.)

Like most cats, the cheetah, the fastest sprinter of all, has limited endurance and is generally exhausted after a dash of several hundred yards. At top speed, cheetahs have been clocked at 70 miles per hour; in one instance, a cheetah was timed as accelerating to a speed of 45 miles per hour in two seconds, covering in that time a distance of 65 yards from a standing start.

Outside of horses, hounds, and cheetahs, however, most animal speeds have been calibrated after a running start over variable distances, making exact comparisons difficult or impossible.

In jumping over obstacles, the height attained would appear to be fairly similar for a number of different animals, including man, although the techniques employed are radically dissimilar in man and quadrupeds. Rarely taken into account, however, is how high (or how far) the jumper's center of gravity has been moved by his effort. When this factor is considered, a three-foot vertical jump from a standing position—a feat often performed by a house cat—is considered an extraordinary jump for a man. In human athletics, nearly all jumping is preceded by a short, bounding run, which may greatly increase the distance attained, especially in a horizontal broad jump. Indeed, the way this jump is performed by track and field athletes today, the take-off is preceded by a sprint at maximum speed, which makes the event a less dependable criterion of sheer jumping ability than a standing broad jump or high jump. In these two jumps, only the strength of the muscles used in jumping determines the distance or height attained.

For horses, the present official high-jumping record is 8 feet 3½ inches. In clearing this height, however, the horse probably raised its center of gravity by no more than 4 feet 3 inches. The remaining vertical distance of 4 feet ½ inch was made up by the way a horse jumps: a horse stands almost upright at the start of a jump and lowers the forepart of its body and legs as its hind legs clear the barrier.

Probably the champion high jumpers are the larger species of

NITED PRESS INTERNATIONAL

DES BARTLETT–BRUCE COLEMAN, INC.

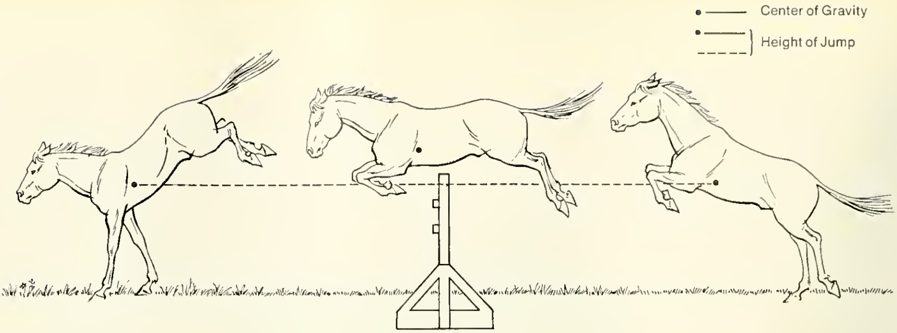
A charging African elephant, above, can reach a speed of 25 mph. Bob Hayes, above right, winning a 100-meter sprint in July, 1963. In June, 1963, he was acclaimed the "world's fastest human" when he was clocked at 27.89 mph at one point in a record-breaking 100-yard race. At the West Flagler Dog Track in Miami, Florida, right, greyhounds chase a mechanical rabbit at speeds approaching 40 mph.

UNITED PRESS INTERNATIONAL

Animals	Speeds in mph
Cheetah	70
Pronghorn antelope	61
Wildebeest	50
Lion	50
Thomson's gazelle	50
Quarter horse	47.5
Elk	45
Cape hunting dog	45
Coyote	43
Gray fox	42
Hyena	40
Zebra	40
Mongolian wild ass	40
Greyhound	39.35
Whippet	35.50
Rabbit (domestic)	35
Mule deer	35
Jackal	35
Reindeer	32
Giraffe	32
White-tailed deer	30
Wart hog	30
Grizzly bear	30
Cat (domestic)	30
Man	27.89
Elephant	25
Black mamba snake	20
Six-lined race runner	18
Squirrel	12
Pig (domestic)	11
Chicken	9
Spider (*Tegenaria atrica*)	1.17
Giant tortoise	0.17
Three-toed sloth	0.15
Garden snail	0.03

DEUTSCHE PRESSE AGENTUR-PICTORIAL

Most of these measurements are for maximum speeds over approximate quarter-mile distances. Exceptions—which are included to give a wide range of animals—are the lion and elephant, whose speeds were clocked in the act of charging; the whippet, which was timed over a 200-yard course; the cheetah over a 100-yard distance; man for a 15-yard segment of a 100-yard run; and the black mamba, six-lined race runner, spider, giant tortoise, three-toed sloth, and garden snail, which were measured over various small distances.



A horse's long body and hind legs enable it to clear heights of almost four feet without raising its center of gravity. Thus, in clearing the four-foot hurdle, above, the horse is jumping—raising its center of gravity—only about one foot.

kangaroos, some of which are known to have cleared a height of 9 feet, which means they raise their center of gravity about 4½ feet.

Using the center of gravity concept as a basis for comparison, human jumpers have attained heights in high jump competitions roughly comparable to animals. But clearing the bar at a certain height and raising one's center of gravity to a certain point are not the same. In going over a bar, the jumper raises his center of gravity by a variable amount, depending on the height of the individual and the technique used to clear the bar.

In a simple, old-fashioned "scissors" high jump, the center of gravity may have to be raised nearly a foot above the bar in order to clear it. In an improved style, the scissors is combined with a "lay-out" as the jumper's body goes over the bar in an almost horizontal position; the center of gravity passes roughly seven inches over the bar. With the technique known as the "Western roll," the center of gravity is about six inches above the bar, and in the presently popular "modified straddle," the center of gravity is very close to the bar, and tne jumper's success depends on his winding his body and limbs over the top.

In humans, the center of gravity is located about two inches below the navel. Thus, in a six-footer, it is about forty-one inches above the soles of his feet. The importance of recognizing this when high jump records are acknowledged is that the taller a jumper is, the easier it is to clear a certain height. Raising one's center of gravity should be the criterion for all comparisons, since obviously, if a jumper's legs were sufficiently long, he could simply step over the bar without raising his body at all.

Cats provide another example of this concept. With the claws of their forepaws cats can reach a distance above the ground equal to the length of their outstretched legs—tip of forepaws to back of hind paws. A tiger can reach upward with its front claws to a height of some nine feet without jumping at all. Therefore, to clear a six-foot wall, a tiger would need to make just enough of a spring to enable it to clear the wall with its front legs, then straighten its body and lift its hind legs over the barrier. Somebody ought to take motion pictures of a tiger or a lion or even a house cat clearing a high wall—one on which the animal cannot secure a claw hold on the way up—to see how much it actually raises the center of gravity of its body. Such a series of pictures would help researchers estimate the true leaping ability of members of the cat family.

Various other examples that could be cited of the leaping abilities of four-footed animals indicate that with few exceptions—the kangaroo and such antelopes as the impala and the klipspringer—the jumps are comparatively little, if any, greater than those attained by human athletes. This simply shows that both humans and animals are designed with approximately the same leaping potential.

In this connection it is regrettable that uninformed writers still persist in comparing the leaping power of a man with that of various small insects. Such comparisons ignore the basic principle that muscular power varies, not directly with body volume or weight, but rather as the cross-sectional area of the muscles. Although this principle was known to Galileo, it continues to be ignored by novelists and movie producers who apparently assume, as did the author of *Gulliver's Travels*, that there is no connection between size and the various bodily capacities. A typical assertion is that if a flea were as large as a man, it could easily leap over St. Paul's Cathedral. Actually, if a flea were that large, it could not stand, let alone jump, for its relatively slender legs would collapse under the weight of its bulky body. The geometry of size dictates that tiny animals can have pipestemlike limbs, but when weight is increased to that exhibited by an elephant, the legs have to be massive supporting columns, quite incapable of enabling the ponderous animal to jump at all.

Whoever coined the phrase, "comparisons are odious," certainly knew what he was talking about. It is unfair to compare human beings with other animals in any one respect, unless we first consider the factors that differentiate the two forms in other respects. When these other factors are taken into account, the probability emerges that as an all-around athlete and physical specimen, a human has few superiors in the animal world. □

Announcements

Expanded Hours at the Museum. We've changed our hours to make visiting the Museum more convenient. The new schedule:

Monday–Saturday,
10:00 A.M. to 4:45 P.M.
Sundays & Holidays,
11:00 A.M. to 5:00 P.M.

It's About Time. The new sky show, which begins March 5, explores the ways in which men have reckoned the passing of years, how the seasons and the calendar fell out of step, and how some canny astronomers invented ways to keep Easters vernal and Christmases snowy. Sky shows are at 2:00 and 3:30 P.M. during the week, with more frequent showings on weekends. Admission is $1.75 for adults, $.90 for children.

The Making of a Python. The nine-foot-long python on display as the March Exhibit of the Month is something of an experiment, according to Dr. Charles J. Cole, assistant curator of herpetology at the Museum. The python model is lifelike in pose and precise in detail. But this "specimen" was not purchased at the expense of an animal's life. Modeled on the live python at the Bronx Zoo, it is completely man-made. The python model will be part of the new Hall of Reptiles and Amphibians scheduled to open next year.

Margaret Mead, curator emeritus of ethnology at the Museum, was recently elected president of the American Association for the Advancement of Science. When Dr. Mead assumes office in January, 1975, she will be the 124th person—and the second woman—to serve as president of the AAAS.

Craft Week in New York City will be celebrated at the Museum's People Center, March 26 through March 31. During the week, a tie-dying workshop will be held and a slide show will illustrate textile techniques, ancient and modern. On the weekend, two Haitian artists—a painter and a sculptor—will be on hand to demonstrate their arts, and visitors will be invited to participate in a silk-screen workshop. For a full schedule of events, telephone (212) 873-4225.

How Do You Get to the Museum? Well, ninety years ago, you might have come in a horse-drawn coach. These days you can still come here in a coach, albeit horseless. This is one of the twenty-two points of interest where the New York City Culture Bus stops on weekends and holidays, between 10:00 A.M. and 6:00 P.M. Just pay $1 and get on and off at as many of the twenty-two places as you care to visit.

Where There's Life . . . Central Park Renewed. Continuous showings of this impressionistic photomontage of winter and the birth of spring in the park will begin March 21, in the Corner Gallery. The eight-minute presentation will be accompanied by an original musical score.

Winged World, a color film narrated by Alexander Scourby, will be screened at 2:00 P.M. on Wednesday and Saturday, March 27 and March 30, in the Museum Auditorium. This 52-minute feature explores the song and flight patterns of birds, how the thousands of living species have managed to survive thus far, and why so many are now threatened with extinction.

The Dinizulu African Dance Group will perform at 2:00 P.M. on Sunday, March 24, in the Auditorium.

On Thursday, March 28, Dr. Francis Hsu of Northwestern University will speak on "The Role of Social Sciences in Chinese Education." This lecture, cosponsored by the Museum and the New York Academy of Sciences, will take place at 8:00 P.M. in the Auditorium.

Impressions of Haiti, a new exhibit in the Education Gallery opened early this month. Photographs and sculpture highlight this visual tour through past and present-day Haiti.

Birds in the Wood. Gallery 77 will feature the sculptures of Gilbert Maggioni and Grainger McKoy in an exhibit opening March 20.

"I DON'T BELIEVE IT!

This new thing actually turns your hand into a vacuum cleaner."

Did you ever hear of such a thing? You put this thing in the palm of your hand—and wherever you place your hand it picks up dirt, lint, crumbs just like a regular vacuum cleaner. Actually turns your hand into a vacuum cleaner. Perfect new appliance for picking up dirt on sofas, drapes, car seats, desk tops—does a fantastic job crumbing the dinner table. Great for billiard table.

Weighs about 10 ounces. Works like a regular sized vacuum cleaner. Has a brush to pick up dirt. Good suction. No bag to empty—just remove top—and empty, the way you would an ashtray.

Works on two regular batteries (not included). A beautifully built appliance, in bright orange. You'll wonder how you passed Monday without it. Money back if not pleased. $9.95 complete.

Wallace Brown
SINCE 1922
Westmoreland Avenue, White Plains, N.Y. 10606

5246C-R1

MAIL NO-RISK COUPON TODAY

WALLACE BROWN, Dept. TVC113
Westmoreland Ave., White Plains, N.Y. 10606

Please send me the following Hand Vacuum Cleaner(s) with full money-back guarantee if I am not delighted.

☐ One for $9.95 ☐ Two for $18.95

Add $1.00 postage and handling for each.

New York State residents please add appropriate sales tax.

Enclosed is ☐ Check for $______
☐ Money Order for $______
or charge my ☐ Master Charge
☐ BankAmericard ☐ American Express

Card Number______ Exp. Date______
Master Charge Bank #______
Signature______
Name (please print)______
Address______
City______ State______ Zip______

DIVISION OF BEVIS INDUSTRIES, INC.

Celestial Events

by Thomas D. Nicholson

Sun and Moon Spring begins on March 20 when the sun arrives at the vernal equinox at 8:07 P.M., EDT. The sun then moves over the Equator to positions above the Northern Hemisphere. It now spends more time above the horizon than below, making the days longer than the nights; it rises and sets to the north of east and west, respectively; sunlight shines through north-facing windows for a period of time each morning and afternoon. These conditions will continue until the sun returns to the Equator next September.

The moon is in the morning sky from mid-March until it appears as an early crescent, low in the west after sundown, about March 26. Thereafter, we will have moonlight during the before-midnight hours until mid-April. Phases are: March 15, last-quarter; March 23, new moon; March 30, first-quarter; April 6, full moon; April 14, last-quarter.

Stars and Planets Winter stars now appear in the western sky at dusk and set about midnight or soon thereafter. In the east, during early evening, the Big Dipper is a good guide to the brighter spring stars in Leo, Ophiuchus, and Virgo. By midnight, you can see the stars of summer beginning to climb over the eastern horizon.

There are only two evening planets in our sky now, Mars and Saturn, close to one another to the right of south after darkness. Both set before midnight. Saturn is the brighter; Mars is to the right and reddish in color. Venus is very bright in the dawn sky, and Jupiter is below it and to the left, just rising in the east about daybreak.

Mercury is in the morning sky in late March, but not well placed for viewing. It passes Jupiter (conjunction) on March 21 for the third time in two months. Triple conjunctions such as this occur when a faster moving planet that is going through its retrograde (westerly) motion, passes one that is more distant from the sun and moving more slowly. Mercury, a swifter-moving planet, passed Jupiter going east on January 27, again going west (as Mercury moved retrograde in passing between the earth and sun) on March 2, and finally going east (as Mercury resumed its direct motion) on March 21. It may be possible to see Mercury close to Jupiter, just below the moon in the dawn sky of the 21st.

March 17: Mars is above Aldebaran, the brightest star of Taurus. The two stars are similar in brightness and color. Mars approached Aldebaran from the right, but it will now separate to the left of the star.

March 18: The moon is at apogee, farthest from the earth.

March 19–20: Venus is near the crescent moon on both mornings.

March 20: Vernal equinox. Spring begins at 8:07 P.M., EDT.

March 21: Mercury and Jupiter are in conjunction with each other and with the late crescent moon.

March 23: Mercury is at greatest westerly elongation, to the right of the sun in the morning sky.

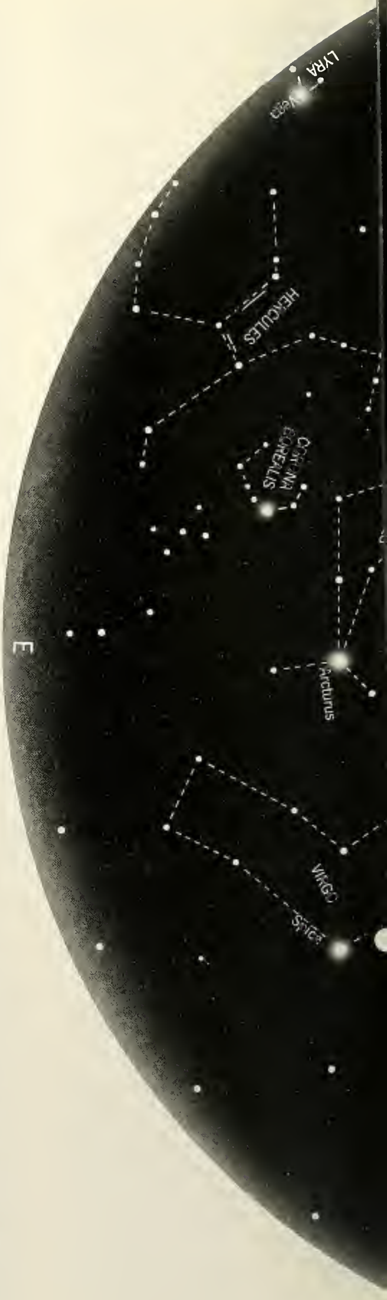
March 29: Mars is to the right of the moon this evening; Saturn to the left. Both planets are occulted (covered) by the moon over the Eastern Hemisphere.

April 2: The moon is at perigee, nearest the earth.

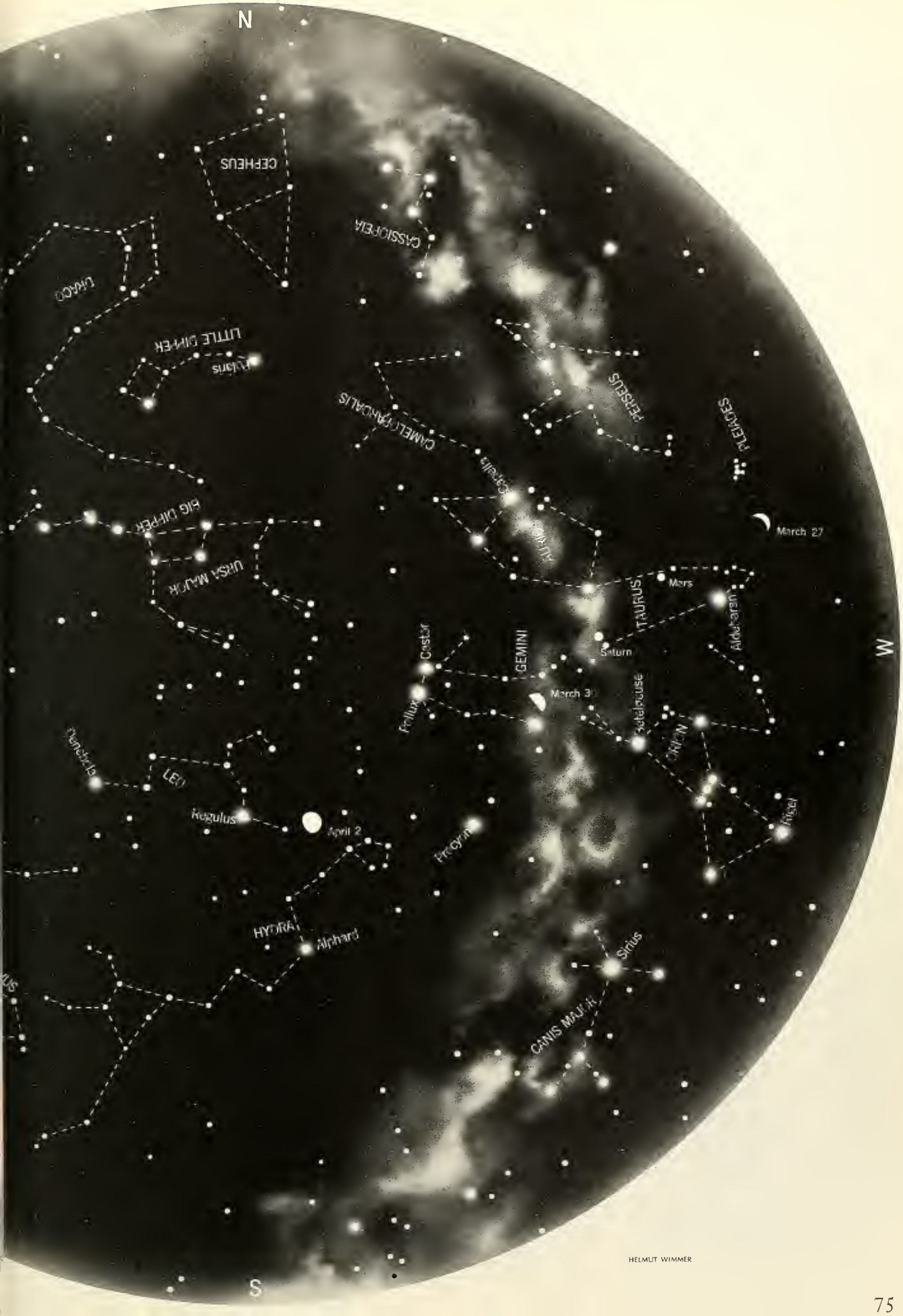
April 4: Venus is at greatest westerly elongation, to the right of the sun in the morning sky.

April 14: The moon is at apogee, farthest from the earth.

April 15: Venus and Jupiter are in conjunction. Look for them quite close to one another in the morning sky. Venus is the brighter planet.



★ Hold the Star Map so the compass direction you face is at the bottom, then match the stars in the lower half of the map with those in the sky near the horizon. The map is for 10:25 P.M. on March 15; 9:20 P.M. on March 31; and 8:25 P.M. on April 15; but it can be used for about an hour before and after these times.


N
CEPHEUS
CASSIOPEIA
DRACO
LITTLE DIPPER
Polaris
PERSEUS
PLEIADES
CAMELOPARDALIS
Capella
AURIGA
BIG DIPPER
URSA MAJOR
March 27
TAURUS
Mars
Aldebaran
W
Saturn
GEMINI
Castor
Pollux
March 31
Betelgeuse
ORION
Rigel
Denebola
LEO
Regulus
April 2
Procyon
HYDRA
Alphard
Sirius
CANIS MAJOR
S

HELMUT WIMMER

A Funny Thing Happened to Comet Kohoutek

A thrown egg, which missed, was the prompt reply when astronomer Edward P. Ney recently asked a University of Minnesota audience its opinion of Comet Kohoutek. Eagerly awaited as the "comet of the century," the celestial visitor has amply rewarded researchers, but it has been a sore disappointment to the viewing public. Kohoutek has been derided by the *Washington Star-News,* as "The Comet of the Month," and satirized by *New York Times* columnist Russell Baker as "The Comet That Couldn't." Its modest glow, which belied our great expectations, has prompted a variety of scientific explanations.

Calculations made last April indicated that Kohoutek ought to outshine the planet Venus and might even rival the brightness of a half moon. Interest focused, of course, on the latter possibility. Somewhat lost in the publicity buildup was the point that maximum luminosity would be attained only as the comet neared perihelion, its closest approach to the sun, on December 28. However, in that proximity, the sun's dazzle would preclude most comet viewing from the earth.

By October, astronomers realized that Kohoutek was not living up to expectations, and that it probably would not exceed the brightness of Venus. This assessment was consistent with the findings of Brian Marsden, director of the Central Bureau for Astronomical Telegrams at the Smithsonian Astrophysical Observatory in Cambridge, Massachusetts, who had analyzed the comet's orbit and concluded that Kohoutek was making its first close approach to the sun. In 1951, the Dutch astronomers Jan Oort and Maarten Schmidt discovered that such "new" comets tend to brighten less strongly than other comets as they approach the sun. Nevertheless, a good show still seemed likely for much of January. Having by then rounded the sun, Kohoutek would head back out into the solar system, coming closest to the earth on January 15. Calculations by William Liller, professor of astronomy at Harvard University, suggested that on that date the visible tail length might reach 18 degrees, or thirty-six times the apparent diameter of the full moon. On December 20, when I faced a Washington press conference with the comet's discoverer, Lubos Kohoutek, I was still confident that his comet would become conspicuous in the ensuing weeks.

Even before perihelion, the comet was a scientific success, thanks to the detection of naturally generated radio signals emanating from its head. These emissions revealed that molecules of methyl cyanide (CH_3CN) and hydrogen cyanide (HCN) were present there. These substances, never before found in a comet, are known to occur in dense clouds in the interstellar space of our Milky Way galaxy, where new stars and solar systems are thought to be forming. Thus, Kohoutek might truly be a sample of the primordial material from which our sun and the earth itself were born.

Measurements made by NASA's Orbiting Solar Observatory-7 satellite on December 27 and analyzed by Martin Koomen, a physicist at the Naval Research Laboratory in Washington, D.C., showed that the comet, now very close to the sun, was brighter than Mercury. During the next few days, Kohoutek did become a genuine spectacle, but only for the Skylab astronauts. They watched it brighten and on December 29 discovered a brilliant sunward-pointing spike, or "antitail."

Most of the treasure trove of comet data collected by the Skylab crew was in the form of photographic film, which could only be developed and examined after the astronauts returned to earth. But a relatively crude, video-transmitted "coronagram"—a picture of Kohoutek passing behind the sun's outer atmosphere, or corona, and actually seen through it—showed that the comet was at least comparable to the brighter stars and might even have exceeded magnitude –3, close to Venus's –4 rating. (The brightness of celestial objects is ranked by magnitudes. The brightest objects are classified as being of negative value, the dimmest are of positive value. The greater the magnitude number, the dimmer the object.) Thus, a celestial show still seemed in the offing for January. If the comet did surpass magnitude –3, it had brightened by a factor of more than forty million since its discovery. Considering the vast range of brightness over which the predictions had to extend, it was not unreasonable to miss by a few magnitudes.

On the evening of December 30, astronomer Robert Roosen, then at the new Joint Observatory for Cometary Research, 10,600 feet up on South Baldy Mountain, near Socorro, New Mexico, spotted the comet. He was apparently the first person on earth to see it after its perihelion passage. "How bright is it?" I asked in a telephone conversation later that night. Roosen didn't know. He had glimpsed Kohoutek through a small, accurately pointed "finder telescope," but he viewed it through clouds that prevented comparisons with stars and planets of known brightness. Cloud cover also hampered observations at many other locations the next evening. Then, on January 1, word came from comet watcher and amateur astronomer Clay Sherrod in North Little Rock, Arkansas, that the entire comet—head and tail—was visible to the naked eye low on the horizon at twilight. Sherrod judged its magnitude to be -1.5, about equal to that of Jupiter or of Sirius, the brightest star. The circumstances of Sherrod's observation rendered it somewhat uncertain, but the magnitude value was smack in the middle of the range, -1.2 to -2.2, predicted by Donald Yeomans, an astronomer at the Computer Sciences Corporation in Silver Spring, Maryland.

Yeomans's computations indicated that on January 4, when the Goddard Space Flight Center was scheduled to launch a rocket payload to study the comet, Kohoutek's magnitude would be between +0.1 and -0.9, comparable to the very bright stars Rigel and Canopus, respectively. But on January 2, physicist Thomas Heinsheimer of Palos Verdes, California, could discern only the comet's head with his unaided eye. A report from Madison, Wisconsin, on January 3 put the comet's brightness at +1, but on that same night a different magnitude was noted at Kitt Peak National Observatory in Tucson, Arizona. Norman Tolk, a physicist and

VISITORS TO OUR HOLLOW occasionally wonder if they can take home a Jack Daniel's whiskey barrel. The answer is yes.

Here at Jack Daniel's we use a very special barrel to deepen our whiskey's color and properly age its taste. It takes years and years to do this job just right. Then we sell the barrels to the Lynchburg Hardware Store, where you can pick them up for $8.50 each. Once you buy a barrel, you can turn it into anything from a coffee table to a bar stool to a barbecue grille. (The man in the picture plans to use his as a dog home!) And there are dozens of other uses. But a sip of Jack Daniel's, we believe, will tell you the most important use of all.

CHARCOAL
MELLOWED
DROP
BY DROP

Tennessee Whiskey • 90 Proof • Distilled and Bottled by Jack Daniel Distillery
Lem Motlow, Prop., Inc., Lynchburg (Pop. 361), Tennessee
The only Distillery placed in the National Register of Historic Places by the United States Government.

TRAVEL THE WORLD OF LINDBLAD

Lars-Eric Lindblad presents
the finest opportunity to see the widest
range of Indian animal and birdlife.

Perhaps only India can offer natural riches and wonder in such profusion—frosty mountains under perpetual snow, vast forests teeming with game and great rivers. Tigers, elephant, Indian rhinos and hundreds of species of birds form part of this photographic "shikkar" in India, Nepal and Sikkim. Included will be the fantastic scenery of Mt. Everest. You will stay in the world's highest hotel and from your room or terrace the mighty Himalayan peaks will always be in view. Many wildlife sanctuaries are on the itinerary. But perhaps the highlight will be the days spent on the seldom-visited preserve of the Royal Family of Jaipur. ***AIR-INDIA*** will fly you there in comfort with its well-known extravagance. Please write for our colorful brochure.

LINDBLAD TRAVEL, INC.
Dept. NHA374
133 East 55th Street, New York, N.Y. 10022
(212) 751-2300

imagine the pleasure of owning your own handsome set of ANTIQUE JAPANESE IVORY CARVINGS (NETSUKES)

YOU CAN START YOUR COLLECTION OF THESE AUTHENTIC REPLICAS TODAY.

These beautiful works of art are faithful reproductions, exact in every detail. There are 24 beautiful pieces in all, offered to you in sets of 4 at only $3.95. For a limited time only you can take advantage of our special offer and order a 12 piece set for only $9.95. Order today and receive **FREE** our specially prepared booklet "The History and Legends of Art Miniatures (The Netsuke)". NH 1

MAIL ORDERS TO: IMG PRODUCTS, INC • 27 E. 39th STREET • NEW YORK, N.Y. 10016

NH 1

Please rush me _____ set(s) of the special limited offer of the 12 piece Art Miniature set @ $9.95 per set and/or _______ 4 piece sets at $3.95 per set. Total enclosed $__________

name ____________________

address ____________________

city ____________ state ______ zip ______

MAIL ORDERS TO: IMG PRODUCTS, INC. • 27 E. 39th STREET • NEW YORK, N.Y. 10016

the leader of a Bell Laboratories team studying Kohoutek with the large McMath Telescope at Kitt Peak, called me to say that the comet, whose tail could be clearly seen through the clear Arizona air, was only +2 magnitude, no brighter than a Big Dipper star. Sherrod's estimate seemed to verify Yeomans's predictions, but only a few days later, the comet was much too dim. On January 4, we had word from the Skylab crew that the comet was now only comparable to the adjacent star Beta Capricorni, a third-magnitude object. (A difference of one magnitude corresponds to a brightness ratio of slightly more than a factor of 2.5.) Was the comet really fading that fast? Comet expert Elizabeth Roemer, of the University of Arizona in Tucson, points out that judging the magnitude of a comet is tricky at best. It was especially difficult for earthbound Kohoutek observers, who, because of the low elevation of the comet after sunset, saw it through a great deal of atmosphere.

My first postperihelion look at Kohoutek came on the evening of January 4. Flying over Pennsylvania aboard a NASA research aircraft, I could perceive with the unaided eye a 5-degree length of yellow tail, about equal to the separation of the "pointer stars" in the bowl of the Big Dipper. The astronauts' estimate seemed to me to have been a little on the dim side, unless the comet was fluctuating in intensity, a not-impossible situation. But as Tolk had reported, Kohoutek was clearly of only second magnitude. I had seen three earlier comets from the ground that were more impressive than Kohoutek looked that night from the air. It was apparent that for the general public the viewing prospects, especially in light-polluted and smoggy metropolitan areas, would be very limited. At a few choice sites the comet did become a superb sight in mid-January as it moved up higher into a darker sky and became visible later in the evening than in the first week of the month. But the rave reviews came from South Baldy Mountain and from Mount Haleakala in Hawaii, which is nearly as high. Scattered reports of naked-eye sightings were received from around the country, some even from cities, but for most would-be viewers, Kohou-

A world tour for a fraction of the price

L.A. MUSIC CENTER
OLVERA STREET
HORSE RACING
UNIVERSAL STUDIOS TOUR
L.A. ART MUSEUM
ORANGE GROVES
MARINELAND
JAPANESE VILLAGE
PALM SPRINGS
LION COUNTRY SAFARI
MARINA DEL REY
HARBOR CRUISES
RIDING HIKING CAMPING
SAN DIEGO ZOO
L.A. LAKERS
ROCK CONCERTS
400 GOLF COURSES
MAGIC MOUNTAIN
DEEP SEA FISHING
DISNEYLAND
SHOP IN TIJUANA, MEXICO
OCEAN FUN

All the things you want to see and do on a perfect vacation are here in Southern California — within easy reach.

You can splash in the ocean — dunebuggy over the desert — bask on the seashore — hike the mountains — all on the same day.

There are more exciting attractions to enjoy than any other place on earth. Rates are unbelievably low — far less than overseas. Everywhere there is endless sunshine to make every day of your vacation count. Take a world tour for a fraction of the price. Come to Southern California.

SOUTHERN CALIFORNIA VISITORS COUNCIL

WRITE FOR YOUR FREE VACATION KIT:
ROOM 149, 705 WEST 7TH STREET,
LOS ANGELES, CA 90017. OR SEE YOUR TRAVEL AGENT.

TRAVEL THE WORLD OF LINDBLAD

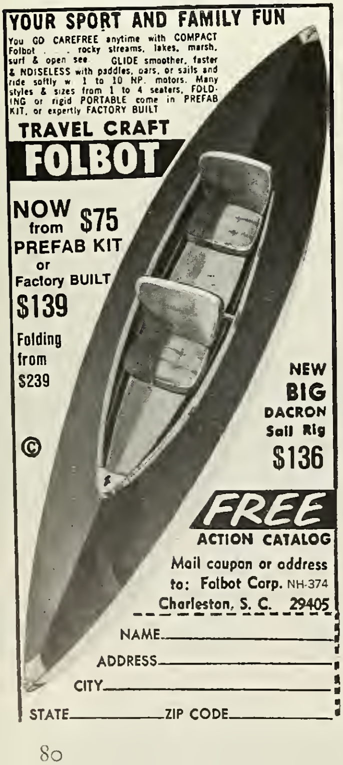
Lindblad's spectacular Explorers' Tour to

CENTRAL ASIA & MONGOLIA

Imagine spending nights under the stars on the Gobi Desert in a Yurt, a Mongolian tent. Imagine roaming around old mosques and bazaars in the ancient city of Bukhara, hardly changed since five centuries ago.

Or exploring the wonders of Samarkand, the "Jewel of the Desert" with its memories of the greatest Mongol of them all, Tamerlane. Imagine covering remote regions of Siberia and Mongolia, meeting many different friendly races, languages, customs and styles of architecture which make up the complex called the U.S.S.R. And finally an evening at the ballet in Moscow. These are only a few of the highlights of this immensely popular Explorers' Tour. **AIR-INDIA** will fly you there in extravagant comfort. The first of ten tours in 1974 is scheduled to depart on June 6. Please send for our informative color brochure.

LINDBLAD TRAVEL, INC.
Dept. NHA374
133 East 55th Street, New York, N Y 10022
(212) 751-2300



YOUR SPORT AND FAMILY FUN

You GO CAREFREE anytime with COMPACT Folbot . . . rocky streams, lakes, marsh, surf & open see GLIDE smoother, faster & NOISELESS with paddles, oars, or sails and ride softly w 1 to 10 HP. motors. Many styles & sizes from 1 to 4 seaters, FOLDING or rigid PORTABLE come in PREFAB KIT, or expertly FACTORY BUILT

TRAVEL CRAFT
FOLBOT

NOW from $75 PREFAB KIT or Factory BUILT $139

Folding from $239

NEW BIG DACRON Sail Rig $136

©

FREE ACTION CATALOG

Mail coupon or address to: Folbot Corp. NH-374
Charleston, S. C. 29405

NAME
ADDRESS
CITY
STATE ZIP CODE

Astonishing cryptograms, deciphered by the author, provide new proof that voyages to the New World were made long before Columbus

Riddles in History

a new book by

Cyrus H. Gordon,
author of Before Columbus

Illustrated $7.95, now at your bookstore, or send check or money order to CROWN PUBLISHERS, 419 Park Ave South, New York, N Y 10016

Crown

tek was the comet that wasn't there.

What went wrong? It is possible that, as already implied, Kohoutek faded very rapidly after perihelion, as did Comet 1897 I, another new comet. Several theories have been proposed to explain such fading. Thornton Page, an astronomer, and Donald Packer, a physicist, both at the Naval Research Laboratory, speculate that the sun's heat may have stimulated chemical reactions in the comet, producing a sticky substance that deterred the outflow of sunlight-reflecting dust particles, thus diminishing Kohoutek's luminosity. Other astronomers think that the low level of activity on the sun in late December and early January left the comet insufficiently stimulated by solar radiation and particles to shine brightly. I don't find either of these ideas compelling. Maarten Schmidt, now at the California Institute of Technology in Pasadena, even doubts that the comet faded rapidly. How accurate are the near-perihelion brightness values? he asks. On the other hand, Luigi Jacchia, an astronomer at the Smithsonian Astrophysical Observatory, working on the assumption that these data are indeed valid, concludes that the comet actually flared briefly in brightness near perihelion when only the astronauts could see it. To check on this, we will have to make a careful analysis of the Skylab photographs, probably the only good records available for that time.

Whether or not Kohoutek dimmed abruptly in early January, its relative brightness when discovered in March, 1973, remains to be explained. It was that luminosity that led to what turned out to be overly optimistic magnitude predictions for the end of the year. One idea, advanced by astronomer E.J. Opik of Northern Ireland's Armagh Observatory, is that in March, Kohoutek was surrounded by a halo of small chunks of frozen water known as ice grains. These would reflect sunlight very effectively and could account for the comet's brightness on its discovery 442 million miles away from the sun. Then, as the comet approached the sun, the ice sublimated, that is, was converted to water vapor, and Kohoutek became largely dependent on its dust particles to reflect sunlight. Observations made this winter, however, show that Kohoutek

You win. Sign me on.

You take the $8. I'll take the year-long Associate Membership in The American Museum of Natural History, including a one-year subscription to Natural History Magazine. That means I get free admission, 10 issues, two free bonus books and discounts at the Gift Shop.

☐ payment enclosed ☐ bill me later

I'll go for broke instead with ☐ 2 years @ $15 ☐ 3 years @ $21

Name ________________

Address ________________

City ________________

State ________ Zip ________

Outside U.S.A., please add $2 per year for postage.

J119

FIRST CLASS
PERMIT NO. 4946
DES MOINES, IOWA

BUSINESS REPLY MAIL

No Postage Stamp Necessary if Mailed in the United States

POSTAGE WILL BE PAID BY—

NATURAL HISTORY
P. O. Box 5000
Des Moines, Iowa 50306

We'll Bet You $8

that you can't name New York's favorite arena for spectator sports

Yankee Stadium?

A pretty good guess. Last year it drew a whopping total of 1,377,176 fans to cheer the Yankees and the Giants.

Shea Stadium?

You're even warmer. The Mets and the Jets combined pulled them in at the rate of 2,096,510 ticketholders during 1973.

But would you believe 2,266,041 at still another New York arena?

Which one would that be? Ours. The 20 buildings and 1,100,000 square feet of floor space that make up the New York headquarters of The American Museum of Natural History on Central Park West at 79th Street.

More people came to visit our blue whale and our dinosaurs...our war canoe and our world-renowned Transparent Woman...than came to cheer Joe Namath or Tom Seaver in action. We hope you were one of them. Or—failing that—we'd like to make sure we can count you into this year's total. For somewhere among the 23,000,000 items we have collected, there are sure to be a few hundred thousand of special interest to you. Which means that if you've lost the bet, you've won yourself a priceless opportunity:

A chance to join (and incidentally help support) one of the world's most distinguished scientific institutions. Free admission comes with your membership, as does a sizable discount at the Museum's well-stocked Gift Shop.

A chance to read and enjoy and *own* for ready reference 10 colorful issues (a year's supply) of the magazine you're holding in your hands right now. *Natural History*—delivered to your mailbox—comes with Museum membership.

Plus a chance to receive—with our compliments—two carefully selected and significant books, printed in Special Members' Editions.

All this is what you win for the modest $8 we bet. If you take us up on the challenge by mailing the card bound over this page, no one can call it a gamble. The returns are sure to be profitable—for you and for every one of the 2,266,041 people who look to the Museum for a mind-stretching, spirit-lifting view of the natural world.

Is it a bet?

If the card is already gone, just address your order to Natural History, P.O. Box 5000, Des Moines, Iowa 50306. Please include the zip code with your address and enclose your check for $8, unless you prefer to have us bill you.

The American Museum of Natural History
Central Park West at 79th Street, New York, N.Y.

was just not dusty enough to become very bright.

A variation on Opik's hypothesis, proposed informally by William G. Fastie, a physicist at Johns Hopkins University, suggests that the comet's initial halo was composed of dust rather than ice and that it was denser than is usual for a comet so far from the sun. At distances of several hundred million miles, far beyond the orbit of Mars, a comet's brightness is often due primarily to reflection by its solid nucleus; the dust cloud only assumes prominence later, as the comet approaches the sun. If Kohoutek is a new comet, Fastie theorizes, it was never before substantially heated by the sun. It may thus have approached that body with an intact surface layer of frozen hydrogen molecules (H_2). Only a slight warming would be required to sublimate this rare solid. If dust grains were embedded in the H_2, they would have formed a bright cloud, or coma, when the comet was far from the sun. Solar radiation pressure is very weak at great distances from the sun, and accordingly would not have pushed the dust out from the coma very rapidly. None of this applies to "old" comets, such as Halley's, which have come near the sun many times. Because their surface layers of H_2 or other volatile molecules have been eliminated by sublimation, such comets do not brighten as much as new ones when far from the sun.

In conclusion Comet Kohoutek may have faded rapidly because of an as yet unexplained disturbance when it came around the sun. Or it may have misled us by looking too bright, too soon, as measured by old-comet standards. Neither or, perhaps, both of these propositions may be true. We will only have a better idea of what happened after all the data are in from the space and ground observatories. The only thing we can be certain of now is that comets are probably the most unpredictable and, at least sometimes, the most impressive phenomena of our solar system.

Stephen P. Maran is head of the Advanced Systems and Ground Observations Branch of the Laboratory for Solar Physics and Astrophysics at the Goddard Space Flight Center, Greenbelt, Maryland, and manager of NASA's Operation Kohoutek.

TRAVEL THE WORLD OF LINDBLAD

Lindblad's Japanese Nature Tour

—a seldom encountered, totally different Japan.

Lars-Eric Lindblad's new Japanese Nature Tour was designed to give you an insight to a Japan – far removed from its industrial complexes – a Japan which is still unspoiled by urban population explosion. Much of the flora and fauna you will come upon has been designated as a special national treasure and a great part of the journey will be spent in national parks. You will visit many islands besides Kyushu, Honshu and Hokkaido. In addition to an abundance of bird and animal life you will see spectacular primeval forests, hot springs, Japan's deepest lakes, wild flowers and oriental botanical gardens. You will devote leisure time in fascinating Japanese Inns. This Japanese Nature Tour is indeed an unusual adventure. There will be five tours in 1974, starting May 4. We suggest you write early for our informative color brochure.

LINDBLAD TRAVEL, INC.
Dept. NHA374
133 East 55th Street, New York, N.Y. 10022
(212) 751-2300

AMERICA'S MOST POPULAR TELESCOPES

For over 20 years UNITRON Refractors have been the overwhelming choice of the amateur astronomer and school observatory. Exploring the skies with a telescope is a relaxing and educational diversion for the whole family—a hobby which is especially meaningful in the space age. UNITRON offers a complete line of 22 time-proven telescopes as well as many unique accessories to increase observing pleasure. All are available for purchase using our Easy Payment Plan.

A free UNITRON Catalog is yours for the asking.

Name____________
Address____________
City______ State______ Zip______

N-21

UNITRON
INSTRUMENT COMPANY, TELESCOPE SALES DIV.
66 NEEDHAM ST., NEWTON HIGHLANDS, MA 02161

Rare Editions for Rare Individuals

If you have a taste for beautiful books and sound investments, you will appreciate membership in The Limited Editions Club.

Only 2000 copies of each Club edition are printed, never more, and they are available *only* to Club members. Leading artists of international reputation are commissioned to illustrate these superb signed editions, each bearing the member's exclusive number.

No effort is spared in the design and craftsmanship of these truly rare — and valuable — editions. And yet the cost is surprisingly moderate.

At the moment there are a few vacancies in the membership. For a Prospectus, you may write the Membership Secretary at Box 17.

THE LIMITED EDITIONS CLUB
Avon, Connecticut 06001

[*There is, of course, no obligation*]

You can help save Pham Thi for $15 a month. Or you can turn the page.

The war is over.
But for an 8-year-old Vietnamese girl named Pham Thi Kim the *other* war—the war on poverty—goes on.

When Pham Thi was still a baby, her family had to flee their village to save their lives. She can't remember her father because he was killed in a raid soon after. Now, the eight members of the Kim family have returned to their tiny three-room hut with its dirt floor and coconut-branch roof. No electricity. No running water. Her mother has returned to her work as a laborer. Twelve hours a day for $1.00. Pham Thi has returned to her studies. Working at night by kerosene. And the fight for survival goes on.

For $15 a month through Save the Children Federation you can sponsor a child like Pham Thi and help her win that fight. To keep her in school with decent clothes on her back and good food in her stomach. To help her neighbors salvage their rice paddies and rebuild their canals.

This then is what Save the Children is all about. Helping people to help themselves. For you there are many rewards. The chance to correspond with a child. To receive a photograph. And progress reports. That's how Save the Children works. But without you it can't work. So please: clip this coupon and mail it today. Now you can turn the page.

Save the Children Federation, founded in 1932, is indeed proud of the handling of its funds. An annual report and audit statement are available upon request. Registered with the U.S. State Department Advisory Committee on Voluntary Foreign Aid. Contributions are income tax deductible.

I wish to contribute $15 a month to sponsor a ☐ boy ☐ girl:

☐ **Where the need is most urgent**
☐ Africa
☐ Appalachia (U.S.)
☐ Bangladesh
☐ Chicano (U.S.)

☐ Europe
☐ Indian (U.S.)
☐ Inner Cities (U.S.)
☐ Israel
☐ Korea

☐ Latin America
☐ Middle East
☐ Southern Black (U.S.)
☐ Vietnam

Enclosed is my first payment:
☐ $180 annually
☐ $90 semi-annually
☐ $45 quarterly
☐ $15 monthly

☐ Instead, enclosed is my contribution of $______
☐ Please send me more information.

Name____________________ Tel. No.__________

Address____________________________

City______________ State_______ Zip_______

David L. Guyer, Executive Director

SAVE THE CHILDREN FEDERATION

345 East 46th Street, New York, N.Y. 10017 NH 3/4

Is Science Really Necessary?

The Greatest Adventure, edited by Eugene H. Kone and Helene J. Jordan. *The Rockefeller University Press, $9.80; 294 pp., illus.*

Suppose it is one of those Victorian times or places where the novel is under attack as immoral and debasing. A patron of the arts authorizes you to produce a defense. You round up a good editor, commission essays from some available authors, and publish. The results, of course, are variable: some authors write abstractedly about the work that concerns them at the moment; others dutifully produce surveys stressing the uplifting tendencies of fiction, trying not to mention the adulterers, prostitutes, and hypocrites who so often appear in novels. No matter. The editor licks the material into shape and the patron soon has the pleasure of holding a well-made volume in his hand.

But the results are decidedly unsatisfactory. The book is read only by those who already believe in the worth of fiction. Those upholders of morality who despise the novel see no reason to change their minds, no matter how much ink is spilled. The novel must limp along as though the book had never appeared.

Make the time now and the subject science and you have *The Greatest Adventure*, a book whose stated aim is to show how scientific research has led to "practical applications that have affected the lives of men," but whose real purpose is to defend science from its enemies. So the book must be judged twice: first, as a collection of science essays; second, as a defense of science.

As an anthology, *The Greatest Adventure* is neither great nor bad. Its major fault is overambition: to cover everything from cosmology (Fred Hoyle) to human speech (George Miller) in fewer than 300 pages is almost impossible. And when the essays do fail, it is for lack of space. Hoyle's thirteen-page summary of cosmology, in which he rides his hobbyhorse of the steady state universe much of the way, is just not long enough. And no one can cover the geological sciences in nineteen pages—with just two pages on plate tectonics—as Richard Jahns tries to do. But John Eccles on neuroscience, G.J.V. Nossal on immunology, and David Hogness on genetics do very well; so do George Miller on human communications and Herman F. Mark on polymer science. None of the essays is as deep as a well, but there are more successes than failures. If the prose is never really outstanding, it is never opaque, indicating that a good editor has been at work. *The Greatest Adventure* sets no new standards, but it meets the old ones very well.

As an answer to the critics of science, the book is, inevitably, less successful. There are two sorts of critics. The first believe we have entirely too much science and technology and would be better off without both. This point of view is, by and large, ignored in the book. There is some justification for this; after all, it is simply impractical to turn back the clock. But *The Greatest Adventure* deals with the problems of technology either by ignoring them—the essay on computers does not mention invasion of privacy; the essay on polymers does not mention waste disposal—or by assurances that those problems are easily solvable. There is an exception, Sheldon Segal's essay on the population problem, but generally the book limits itself to the good side of science.

The reason for this approach seems to be a dominating interest in answering the other group of critics: those practical men who believe that science should be producing more practical results to justify the money spent on research. There is an obvious reason for aiming at these critics, since they include the people who decide how much money goes to scientific research; anything that reaches them will pay off in dollars.

The Greatest Adventure attacks these critics on two flanks. It opens with Isaac Asimov saying that basic research needs no justification, but if you are foolish enough to ask for it, then how about Faraday's generator, Edison's electric light, Einstein's $E = mc^2$? It closes with Gerard Piel's essay, perhaps the best in the book, deriding mission-oriented research and defending basic science as a noble intellectual discipline. The essays sandwiched between generally lean more toward the Asimov line.

As a defense of science, *The Greatest Adventure* has to be judged a failure, not because of anything specific in it, but because the very attempt is a mistake. You cannot justify science on practical grounds any more than you can justify music or art or literature. If you must start pleading practical benefits—that the symphony increases productivity or that painting is good interior decorating or that the novel uplifts morals—you are talking to the deaf and have lost the argument before it begins. One either accepts these as self-justifying activities or one rejects the idea; there is no middle ground.

The same is true of science, but with a complication. It is true that science—or much of it—can be justified on purely practical grounds, on a historical record showing that investment in basic research has produced advances in technology and medical practice. Indeed, aside from some lip service paid to the ideals of science, its practical benefits are the only justification given by most people these days for support of scientific research. And that is a mistake, as a comparison with other forms of creativity shows. In this country, artists, writers, and composers generally are starved for money. But when they are given government grants, there are no

Buried cities · polar bears · penguins · dragon lizards · drifting continents – sooner or later all the natural world reveals its secrets to members of the

NATURAL SCIENCE BOOK CLUB

Just about every fascinating facet of the natural world comes under the scrutiny of the NATURAL SCIENCE BOOK CLUB in books sure to delight the eye, quicken the pulse, expand the intellect, transport the mind to times past and times ahead. You're only a postage stamp away from enthralling adventure at welcome savings!

The Polar Worlds
Beginner's Guide to Archaeology
POWER PLAY
LEONARD MOSLEY
GIANT REPTILES
Sherman A. Minton, Jr. and Madge Rutherford Minton
EXPLORING THE OCEAN WORLD
C. P. Idyll
safari South America
Christina Wood

(retail prices shown)

69711. THE POLAR WORLDS. *Richard Perry.* A fascinating parallel between the environments of the Arctic and Antarctic and the native species which inhabit them; in Antarctica, the penguins, seals, and whales; and in the Arctic, the walruses, caribou, and polar bears. **$7.95**

35751. BEGINNER'S GUIDE TO ARCHAEOLOGY. *Louis A. Brennan.* The techniques and background information that will enable anyone to find, survey, test, excavate, preserve, analyze and record artifacts and other evidences of prehistoric life. Includes state by state lists of existing sites. **$9.95**

69621. POWER PLAY: Oil in the Middle East. *Leonard Mosley.* Behind-the-scenes look at the explosive oil situation in the Middle East. Offers clues to the political and environmental crises we find ourselves in today as well as being a crackling good history. **$10.00**

61210. MATHEMATICAL THOUGHT FROM ANCIENT TO MODERN TIMES. *Morris Kline.* Magnificent survey of the "queen of sciences" will delight and enlighten anyone whose curiosity responds to the excitement of ideas. *Counts as 2 of your 3 choices.* **$35.00**

50281. GIANT REPTILES. *Sherman A. Minton, Jr., and Madge Rutherford Minton.* A storehouse of information of the giant reptiles of the world — the crocodiles and alligators, the giant tortoises of the Galapagos and Aldabra islands, the sea turtles, the dragon lizards of Komodo, and more. Illustrated. **$9.95**

32720. AMATEUR ASTRONOMY. *Patrick Moore, F.R.A.S.* Practical advice for beginners, technical data for students in astronomy. Basic equipment, important techniques and a guide to the heavens — from asteroids to zodiacal lights. **$6.95**

54100. HUMAN SEXUALITY: Second Edition. *James Leslie McCary.* A best seller in its original trail-breaking version, this revised and updated edition of the best marriage manual available provides sound and sensible information on the physiological, psychological, and sociological aspects of sex. **$14.50**

Take any 3 books

(values to $49.95)

for only 99¢ each

If you will join now, and accept only 3 more books within the next 12 months — all at stunning member discount prices.

47340. EXPLORING THE OCEAN WORLD: Revised and Expanded Edition. *Edited by C. P. Idyll.* This richly illustrated volume is the non-professional's ideal introduction to oceanography. Leading scientists explain continental drift, marine ecology, exotic underwater life, man's future in the sea, much more. **$14.95**

55561. THE INSECT SOCIETIES. *Edward O. Wilson.* "For anyone, layman or specialist, interested in a single, concise, lucid, and authoritative account of the most significant facts and theories about insect societies, *The Insect Societies* is the best available and will be for many years." —*Natural History. Counts as 2 of your 3 books.* **$20.00**

36141. BEYOND STONEHENGE. *Gerald S. Hawkins.* The internationally famous astronomer and author assesses the astronomical significance of ancient sites such as the temples of the Nile, Mayan ruins, the enormous linear drawings in the Peruvian desert, and the huge geometrical earthworks of the U.S. **$10.00**

84451. TOWARD A GENERAL SCIENCE OF VIABLE SYSTEMS. *Arthur S. Iberall.* The distinguished scientist-author presents a seminal and challenging work embracing all scientific phenomena, from mathematical and physical fundamentals through the solar systems and galaxies to the cosmos. **$14.50**

73451. THE RAW AND THE COOKED / FROM HONEY TO ASHES. *Claude Lévi-Strauss.* Brilliant anthropologist's trail-breaking exploration of the basis and interrelations of myths in primitive man. Two-volume set provides some of the most provocative reading in many a year. *The set counts as 2 choices.* **$26.00**

75060. SAFARI SOUTH AMERICA. *Christina Wood.* The dramatic, and sometimes dangerous incidents surrounding a jungle rescue mission to save several thousand wild animals trapped by the rising waters of a hydro-electric dam. Fascinating observations of jaguars, capybaras, boa constrictors, and Saki monkeys, among others. **$7.95**

68720. PHYSICAL FITNESS & DYNAMIC HEALTH. *Thomas K. Cureton, Jr.* One of the world's truly famed authorities takes a hard look at the problem of maintaining good health in an age of convenience. Sets forth practical and original views on what physical fitness really means. Recommended for men and women of all ages. **$7.95**

HOW THE CLUB OPERATES • The Book Club **News**, describing the coming Main Selection and Alternate Selections, will be sent to you 15 times a year at three to four week intervals. • If you wish to purchase the Main Selection, do nothing and it will be shipped to you automatically. • If you prefer one of the alternates or no book at all, simply indicate your decision on the reply form always enclosed with the **News** and mail it so we receive it by the date specified. • The **News** is mailed in time to allow you at least 10 days to decide if you want the coming Main Selection. If, because of late mail delivery of the **News**, you should ever receive a Main Selection without having had the 10-day consideration period, that Selection may be returned at Club expense. • After completing your trial membership, you will be entitled to take advantage of our fabulous bonus plan which offers savings up to 70% and more.

Natural Science Book Club
Riverside, New Jersey 08075
4-78A

Please accept my application for membership and send me the three volumes indicated billing me only 99¢ each. I agree to purchase at least three additional books during the first year I am a member at special members' prices. Savings range up to 30% and occasionally even more. My membership is cancelable any time after I buy these three books. A shipping and handling charge is added to all shipments. **Send no money. Members are billed when books arrive.**

3 BOOKS FOR 99¢ EACH. Indicate by number the 3 books you want.

Some expensive books count as 2 selections.

☐ ☐ ☐

Name____________________

Address____________________

City__________State_______Zip_______

(Offer good in Continental U.S. and Canada only. Prices slightly higher in Canada.)

Share the Thrills of Exploring Outer Space!

$219.95 f.o.b. Hartford, Conn.
$15 Crating Charge

All DYNASCOPES, including this superb RV-6, 6-inch available on easy terms!

Now it's easy to join the thousands of serious amateurs who have discovered the excitement of exploring our mysterious universe. Your enjoyment begins right from the start, yet the challenges and rewards go on for years! And it's a hobby that can be shared at modest cost.

Choose From Many DYNASCOPES®

Picking a telescope to fit your needs and your pocketbook is simple when you select a DYNASCOPE—the same instruments used by more than 150 schools, colleges and observatories—and your satisfaction is guaranteed by a full-refund warranty.

FASCINATING GUIDE YOURS FREE!

Read these valuable facts before buying any telescope. Mail coupon or postcard for your complimentary copy of this helpful guide.

Criterion Manufacturing Co.
331 Church St., Hartford, Conn. 06101
® TM Registered U.S. Pat. Office

CRITERION MANUFACTURING CO., Dept. NH-46
331 Church St., Hartford, Conn. 06101
Please send your free Telescope Guide.
Name
Address
City State

CROWDER NATURE TOURS

. . . resuming after a lapse. The original overseas Nature Tours; started in 1961 several years before the first others joined the field. Still have an amazing world coverage. Do you have our famous "Tour Book"?

Emphasis principally birds, under expert leadership, but non-birders also find our offbeat routes of extraordinary interest. A non-profit operation.

PROGRAM FOR 1974
(No. Am. trips 2 wks.; all others 3 weeks)

¹Tropical America: March-April-May (6 tours)
²Europe: June-July (5 tours)
Africa: East Africa June 29; Madagascar July 20
³South Pacific: July-October (7 tours)
Himalayas: Sept. 7 (Nepal-Bhutan-Brahamaputra Valley)
South America: September (Colombia; Venezuela-Guianas)

¹Tropical America series now firming up: Florida March 9; Yucatan March 23; Mexico East Coast April 6; Texas-Northern Mexico April 20; California May 4; Arizona May 25.
²Europe: Scottish Islands June 6; Mediterranean June 6; Norway June 29; Middle East June 29; USSR (six weeks, all 15 Soviet Republics, plus Outer Mongolia and around the world) July 20.
³South Pacific: Very heavy coverage; if at all interested, do write.

1975 Tours Schedule Now Available on Request.

CROWDER NATURE TOURS
NOTE: Unannounced tours often run; what is your interest?
Box 222-a
Harpers Ferry, W. Va. 25425

strings attached—it would be absurd for the government to set the rules of composition.

The only reason for such freedom is that the government does not believe art, literature, or music to be of any practical use. This is not the case in other countries, notably the two large Communist states, the USSR and China. In these states, the arts are taken very seriously as being of great practical importance, and writers, composers, and painters are kept on correspondingly short leashes. Only government-approved compositions can be made public; serious work is an underground effort. Scientists in these countries are given more freedom than artists, but only because they have convinced their rulers that a minimum amount of freedom is needed to produce the practical results that the politicians want.

The situation is different in democratic nations. Here scientists started from total freedom and have worked themselves into a position where their freedom of action is being constantly limited by state directive, implicit or explicit. The reason is the world's oldest: money. Modern science is an expensive proposition, and it is a temptation for a scientist to get the money he needs by promising that his basic research will produce practical benefits. But if that argument is used often enough—and it is the implicit basis of *The Greatest Adventure*—politicians begin to get the idea that the practical results will come sooner if scientists stop dithering about and follow businesslike methods.

Logically, scientists should not complain about this. If a young virgin wheedles money from an old lecher with promises of future delights, there should be no shocked surprise when those delights are demanded. But scientists, being human, would like to have both the money and their virginity; they would like to lead the politicians on to a point and then stop. *The Greatest Adventure* does yield to this temptation. While most of its contributors are sincere in their defense of basic research—Piel is most eloquent—there is an overhanging impression that virginity is something of a bore and the attentions of the lecher are rather welcome.

The trouble with this approach is that it leads to disaster, as in the

Bean's Outdoor Sporting Specialties

FREE Spring Catalog

Just off the press, our new Spring Catalog. 120 fully illustrated pages of fishing and camping equipment. Outdoor apparel and footwear for men and women. Includes many items of our own manufacture.

Our 62nd year of providing dependable, high grade sporting and outdoor specialties. All fully guaranteed.

☐ Send Free Catalog.
Name
Address
Zip

L.L. BEAN INC.
620 Main Street, Freeport, Maine 04032

ARCHAEOLOGY

OLMEC Visit
CHALCATZINGO – LA VENTA
SAN LORENZO – IZAPA

Visit GUATEMALA
UAXACTUN – SEIBAL – NAKUM – QUIRIGUA
YAXHA – KAMINAL JUYU

YUCATAN MAYAPAN
TULUM – RIO BEC
Join an educational expedition led by bilingual professional maya archaeologist.

BIRD WATCHING
QUETZAL – LAKE ATITLAN GREBE

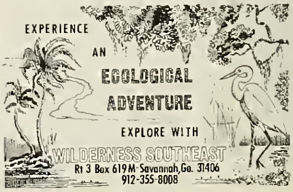
TROPICAL HORTICULTURE
BANANA and SPICE PLANTATIONS
ORCHID GARDENS – JUNGLE BEAUTY
PRIMITIVE MILPA AGRICULTURE

PERU · COLOMBIA
CHAN CHAN – PACHACAMAC – GOLD
Accompanied by 2 U.S. Archaeologists both with previous excavation experience in Peru.

WRITE FOR DETAILS
Educational Programs in Archaeology and the Natural Sciences.

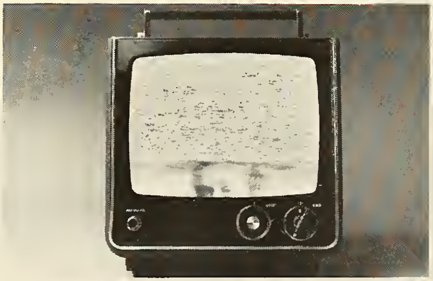
Charles Boogher
Expeditions Extraordinary
Apartado Postal 63
Guatemala City
Central America

NATURAL SCIENCE

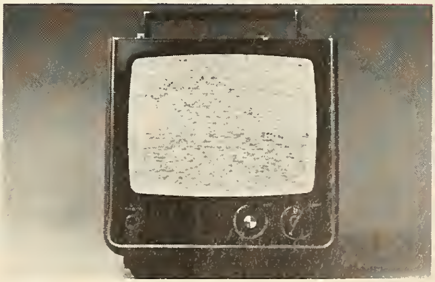

EXPERIENCE AN ECOLOGICAL ADVENTURE
EXPLORE WITH
WILDERNESS SOUTHEAST
Rt 3 Box 619M-Savannah, Ga. 31406
912-355-8008

The real
The news media, both broadcast and print, continue to be the center of controversy. Have they gone too far or aren't they going far enough?

The very heart of a democracy is an open free-flow of information. Without it, our system of government cannot exist. A non-informed electorate is no electorate at all. Without freedom to investigate and report the news from every angle, the members of the press become corporate and government spokesmen. We must keep the channels of communication open to all, even when it hurts.



The ideal
An open society in which information is passed freely back and forth.
The more we know, the better off we are.



AtlanticRichfieldCompany

BOB CAMPBELL

We'll die ..!

Survival of the fittest and fleetest on E.Africa's plains is hard enough, without poachers, their snares and fires added to our battle. They, and those who sent them, are after our skins, hides, furs, claws, hooves, horns and teeth. But believe me, we need them more than they. However if we don't get help soon, we'll go the same way as the Dodo. To extinction.

You are our hope and our help, and the link between us is the EAST AFRICAN WILD LIFE SOCIETY, East Africa's own conservation group, and the first of its kind in the tri-nation area of Kenya, Uganda and Tanzania.

It is non-profit, non-governmental, a body that has funded a list of conservation projects since 1961, as long as your arm. Every cent of your membership (US$11.00) goes directly to game conservation projects; and not one cent to "overheads".

THE *WILDLIFE* GETS ALL THAT YOU GIVE

As a member of the Society you will also receive a year's subscription to AFRICANA the quarterly wildlife magazine. And for those who are interested in gifts of every description which have to do with the game of East Africa, a 32 page colour brochure is available for US$ 1.00. They are also on sale from our gift shop and gallery in the Nairobi Hilton Hotel.

And while you're reading this, remember, that the Society is working round the clock on our behalf, in the field of education, anti poaching, research and animal rescue.

USA Representative:
Miss Alice Smith Box 1325, Chicago Ill. 60690

EAST AFRICAN WILD LIFE SOCIETY
Box 20110 Nairobi Kenya.

Please enrol me as a member.
I enclose US.$11.00 for my year's membership.

Name ______
Address. ______

case of the current war on cancer, perhaps the most ill-advised scientific project ever undertaken. We got into this because a few enthusiastic physicians and some badly informed laymen told Congress that the time is ripe for the total conquest of cancer—a statement as close to complete untruth as is possible, but one that proved irresistible to legislators.

The result has been a systematic starvation of other areas of biomedical research, a clamor by other pressure groups to be cut in on the goodies, and a frightening distortion of biological research. (There is a story current about a researcher who, in applying for funds, wrote in disgust, "This has nothing to do with cancer," and who got the grant because the word "cancer" was on the application.) As an added problem, science soon gets blamed for the excesses that are committed by such patrons. Scientists argued against using the atomic bomb, but it is scientists, not politicians, who are blamed for Hiroshima. It could be argued that scientists as a group have slightly cleaner hands than the rest of us, but it must also be admitted that many scientists are all too ready to do exactly as they are told and will promise almost anything for the sake of a grant.

So what's to be done? The options are limited; virginity cannot be restored. Probably the best tactic is to divide research into two areas. One would be intensely practical, closer to engineering than science—an effort aimed at meeting the immediate needs of society. The other could be described as totally useless—as useless as the novel or the symphony—one that should be supported solely for esthetic reasons. (Some scientists, notably astronomers, have been using this argument quite effectively for some years.) Efforts such as *The Greatest Adventure*, where basic research is justified on practical grounds, would thus be eliminated.

And once basic science is established as a useless but decorative enterprise, on the level of the symphony orchestra, scientists could then join the rest of us in trying to change society so the fruits of science could be handled better.

Edward Edelson is science editor for the New York Daily News.

Preserve and protect your copies of Natural History

only 3^{95} each

NATURAL HISTORY FILE—
holds a year's subscription—keeps all copies neat, clean and in one place

A deluxe Royal Blue magazine case with "Natural History" gold stamped on the face. Has the expensive good looks of a leather-bound book. Organizes your valuable collection by year of issue. Reduces clutter in your home or office, keeps copies handy for easy reference. Sturdy bookbinder's board protects copies against soil and damage for as long as you want to keep them. Gold leaf furnished free for dating, etc. Measures 11½"H by 3"W by 8½"D. Send check or money order. Money refunded if not satisfied.

Natural History File........$3.95 ea.; 3 for $10.00 postpaid

We have custom designed files for over 8000 magazines. Order by title, $3.95 ea. ppd.

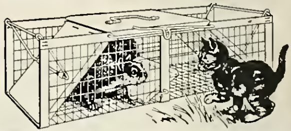
SHANNON, INC.
734 Decatur Avenue North, Minneapolis, Minn. 55427

As in 1973, we invite you to join the veteran Himalayan mountaineer, Mr Lute Jerstad, on a

Himalayan Trek in Nepal

November 16, 1974 and January 25, 1975
These adventurous expeditions are unique not only due to the expert leadership, but because they combine a trek on foot in the Annapurna region with a trek on elephant back through the Terai jungle, and a canoe trip on the Rapti River. Between the treks, first class hotel accommodations are provided; and the expedition ends with four days in Northern India, visiting Delhi, Agra and Jaipur.
Detailed brochure available from:
HANNS EBENSTEN TRAVEL, INC
55 WEST 42 STREET, NEW YORK, NY 10036
TELEPHONE (212) 354-6634

CATCH THEM ALIVE AND UNHURT!



Amazing HAVAHART trap captures raiding rats, rabbits, squirrels, skunks, weasels, etc. Takes mink, coons without injury. Straying pets, poultry released unhurt. Easy to use —open ends give animal confidence. No springs to break. Sizes for all needs. FREE booklet on trapping secrets.
HAVAHART, 158 Water St., Ossining, N. Y. 10562
Please send new guide and price list.
Name ______
Address ______ Zip ______

Imagine a land where you can inhale the perfume of pine beside a roaring waterfall.

Cup your hands and drink deeply from a crystal-clear creek. Discover the strange mystery of mist-shrouded Forbidden Plateau. Imagine a land where you can breathe the incense of salt, cedar and seaweed on a forgotten stretch of beach.

Imagine a land where you can stroll through an English city where flowers bloom the year round. Experience a metropolis on a harbour rimmed by towering mountains you can hike on in Summer and ski down in Winter, a metropolis where you can walk in a thousand acre park just minutes from elegant hotels.

Drive through orchards that are frothy white in Spring and crimson red in Fall. Savor the Summer taste of cherry cider from a roadside fruit stand. Take in a rodeo. Discover a ghost town.

Imagine a land of seacoast. Mountains. Lakes. Rivers. Rangeland. Desert. Wheatfields.

Imagine a vacation you'll return from with a thousand faces indeliby impressed on your mind and in your memory.

This is British Columbia, Canada.

After visiting British Columbia, stop off at the B.C. Pavilion at the Spokane World's Fair. See your travel agent for information on all-inclusive package tours or write the Department of Travel Industry, 1019 Wharf Street, Victoria, B.C., Canada, V8W 2Z2.

The Polished Alabaster Owls of Volterra

A
WALLACE BROWN
EXCLUSIVE

Simple in line, royal in his elegance is this wondrous sculptured owl from Italy's famous Alabaster quarries of Volterra, near Pisa. Hand-polished, sophisticated, magnificent, he regards you with infinite (but quixotic) wisdom. About 4" high in heavily marbled, luscious pearl grey, with black and yellow deep set eyes, he weighs a hefty seventeen ounces (paperweights anyone?). Very worldly in price, too...just $7.95. To be wise, surprise someone you love with a unique gift and save in the bargain ...so order two for only $14.95.

Please add 50¢ to partially cover the postage and handling of each of your orders, which will be cheerfully refunded if you are not ecstatic about your Wallace Brown Alabaster Owls.

MAIL NO-RISK COUPON TODAY

5121B

Wallace Brown
SINCE 1922

Dept. AV-158 Westmoreland Avenue
White Plains, New York 10606

Please send me the following Alabaster Owls with complete money-back guarantee, if I am not absolutely delighted.

☐ one for $7.95 ☐ two for $14.95

(Add 50¢ for postage and handling for each owl ordered.) New York State residents please add appropriate sales tax.

I enclose ☐ check ☐ money order for $__________

or charge my ☐ American Express or ☐ BankAmericard

☐ Mastercharge Interbank #__________

Card Number__________ Exp. Date__________

Signature__________

Name (print clearly)__________

Address__________ Apt. #__________

City__________ State__________ Zip__________

DIVISION OF BEVIS INDUSTRIES, INC.

THE BONE HUNTERS, by Url Lanham. *Columbia University Press, 285 pp., $12.95; illus.*

Url Lanham writes of the heroic age in American paleontology. It began at the end of the nineteenth century with Thomas Jefferson speculating about possible lions or mastodons living somewhere west of the Blue Ridge. The fossils of great claw, or Megalonyx, which Jefferson had recently received, might be that of a huge lion still alive out there. The heroic age ended with the discovery, not of living giants, but of even more remarkable extinct monsters, the dinosaurs of the Jurassic, the flying reptiles, the toothed birds, and the bird-brained titanotheres, nature's first attempt at a rhinoceros.

Marsh and Cope, rival tycoons in the new field of vertebrate paleontology, were as single-minded and opportunistic in their race to discover and describe the fossils as a Rockefeller or a Vanderbilt building an industrial empire. O. C. Marsh, the Peabody heir who created his own Yale professorship, was sometimes called "Oh See Marsh," but never Othniel.

His nemesis was an exuberant Quaker and master naturalist, Edward Drinker Cope. Cope described twice as many fossil species as Marsh, not to mention a wealth of living species of fish, snakes, lizards, and turtles. When he feared being scooped, Cope sent type descriptions to the American Philosophical Society by telegram.

Marsh enjoyed John Wesley Powell's support and that of the U.S. Geological Survey, which had its own political reasons for seeking an identification with Marsh's Yale image. Marsh recruited a retinue of field collectors and a personal staff of expert research associates that he managed to dominate and antagonize. (Some turned into strong Cope sympathizers.) Marsh's men were known to backfill their quarries virtually on top of Cope's collectors. So Cope would not find them, they destroyed fossils they couldn't remove themselves. Two Marsh men almost came to gunplay in a territorial dispute, which Marsh seems to have set up, intentionally or not. Marsh was often negligent in reimbursing his crews, and one collector managed to pay his bills by his winnings at poker.

26 top specialists show all the ways science is giving nature another chance.

NIGEL CALDER, Editor

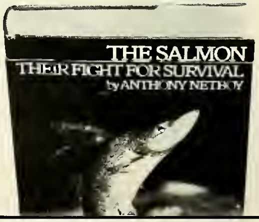
NATURE IN THE ROUND

A GUIDE TO ENVIRONMENTAL SCIENCE

A collection of original essays about our current ecological knowledge and the role of traditional sciences in keeping our planet green and alive.
$8.95

THE VIKING PRESS
625 Madison Avenue • New York, N.Y. 10022

"An encyclopedic study"
—Publishers Weekly



"Rarely has an author dealt so well and so completely with the holistic nature of an ecological drama so that the layman could understand and the expert could value the study. Netboy spent years researching and assembling the pieces to this living puzzle; and his narrative style carries the reader through a fascinating maze of facts."
—Library Journal

"Netboy's writing is so pristine, his information so fascinating, that after a toe in there's no resisting the plunge. . . . certainly definitive on the subject."
—Kirkus Reviews

Illustrated with photographs, maps and charts. Appendix. Index. $15.00

At your bookseller

HOUGHTON MIFFLIN COMPANY
2 Park Street, Boston 02107

The last different place. Africa.

Experience it now. Sabena has six Safari Tours from $1210.

One place in the world still teems with wonders, sights and adventures that can be experienced nowhere else.

That place is Africa.

Let Sabena guide you there across vast plains to Nature's last stand, Africa's game preserves and national parks. Watch the great game herds gather from a treetop hunting lodge. Rise early for a sunrise view of Mt. Kilimanjaro's snow-capped peak. Fly over breathtaking Victoria Falls for spectacular views. Or see two great oceans meet at the Cape of Good Hope.

Sabena Safari Tours bring you in contact with Africa's many aspects, the incredible landscapes and natural wonders, the art forms and culture, and the still abundant wildlife, in a choice of six unforgettable African holidays.

Choose tours of 17 to 28 days, prices from $1210 to $2968. Then choose the Africa you want to discover: West Africa's Ivory Coast, Ghana, Dahomey and Nigeria; East Africa's Kenya and Tanzania; or modern South Africa and Rhodesia.

For Safari Tour information, mail the coupon below, call Sabena Belgian World Airlines, or see your travel agent.

HOLIDAY ABROAD
SABENA
belgian world airlines

Sabena Belgian World Airlines
Holiday Abroad Manager, Dept. H
125 Community Drive
Great Neck, N.Y. 11021

Please send me information on Sabena African Safari-Tours plus the new Holiday Abroad Tour Catalog, filled with travel adventures to Europe, Africa and the Middle East.

Name ______________________________
Address ______________________________
City ______________ State __________ Zip __________
My travel agent is ______________________________

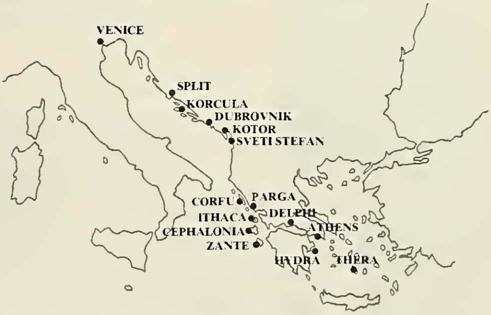
A Cruise for Museum Members

As announced last month, a group of members of the Museum will be leaving New York on May 16, 1974, returning on May 27, and sailing aboard the M/V *Neptune* from Venice to Athens in between.

Dr. Thomas Nicholson, Director of The American Museum of Natural History, and Mrs. Nicholson will be aboard. Dr. Nicholson will discuss and teach celestial navigation and astronomy. As you sail south to Ithaca, legendary birthplace of Ulysses, Dr. Nicholson will help you understand how, 3,000 years ago, Ulysses steered his hazardous course.

Also along will be Mrs. Barbara Halpern, the cultural anthropologist who built the Museum's collection of Yugoslav costumes and artifacts, and David Gordon Mitten, James Loeb Professor of Classical Art and Archeology at Harvard University. We want you to have a vacation and a chance to learn, too.

It will be springtime in the Mediterranean world, and we hope you'll want to be there.



Rates, which include airfare and a tax-deductible contribution to the Museum, start at $1185. For the comfort of our passengers, participation is limited to two-thirds of the capacity of the vessel. Write now for further details: Mrs. Marie Caufield, The American Museum of Natural History, Central Park West at 79th Street, New York, New York 10024.

Marsh made friends with the Sioux. In exchange for an opportunity to collect on their reservation, he carried defective foodstuffs that they had received from the Indian Agency to Washington in a confrontation with the Grant administration. The scandal led to the resignation of the Commissioner for Indian Affairs. On the other hand, the Sioux had every right to be suspicious, not of Marsh, but of the motives of the military party guarding his camp in the Black Hills. The Army has not manifested such a keen interest in fossil bones since.

In pursuit of their shared passion, both Cope and Marsh "frittered away" most of their inherited wealth. Cope had less to lose and lost more heavily. He came to ruin in a final, wild effort at silver mining in southwestern New Mexico, which he personally supervised when not hunting for new species of reptiles in the hills. Cope loved field work and did much more of it than Marsh, who turned into an armchair scientist after an initial round of expeditions in the 1870s. Cope hermetically sealed and sent home to his family the fresh flowers of the plains and prairie.

When driven to bed by illness or exhaustion, Cope managed to recover with (or despite) ample doses of his favorite remedy, a mixture of quinine, belladonna, and opium. Evidently, these drugs did not interfere with his real addiction, the search for the new and unknown.

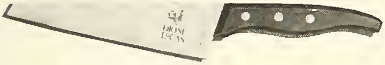
In poetic descriptions of a land he knows and loves, Url Lanham follows the bone hunters over the Mauvaises Terres, or Badlands, of Kansas, Utah, Nebraska, the Dakotas, and into the most famous fossil field of them all, the Como Bluff west of Laramie, where dinosaur bones lay like logs scattered on a forest floor. Lanham ends with the newspaper attack that Cope launched when, apparently at Marsh's instigation, the Secretary of the Interior demanded that Cope turn over his Tertiary and Cretaceous collections to the National Museum. Cope and Marsh attacked each other's scientific competence, honesty, and integrity. A bemused public was entertained by an opportunistic press.

Was it all worth it? Certainly the science of taphonomy, of how animals die and become fossils, was blighted by the plunder of the bone

"You have ruined my Volaille"

How Dione Lucas (of Cordon Bleu fame) came to create the most remarkable knife in the world. A knife you can now own.

Not an inexpensive knife.



I am told by my friends who pride their cooking, that this is just that—a remarkable knife that brings a new celebration to cooking. Its balance is such, its blade so acute, that with a small flick, you can pare fat from the shank of meat.

That, some remember, is exactly how gourmet great, Dione Lucas, came to create this remarkable knife.

Her recipe for Supreme de Volaille called for carefully removing all the fat from the tender meat.

A trace of fat would cause the sauce supreme to spot. "You have ruined my Volaille," she said. For no knife satisfied her with its truth of edge.

It is completely within the bounds of safety to say that once you own the Dione Lucas Gourmet Knife, you may never again have to purchase a knife for your kitchen.

In fact, that is the way we guarantee these remarkable knives. Should you ever need a replacement for any reason, simply return the knife, and a new knife will be sent to you, at no cost to you.

How can such confidence be placed in what would appear to be a simple knife?

A most special steel of molybdenum mix is used in the manufacture of the blade. This blade keeps its edge for life with simple honing.

Then there is the balance I spoke of. When you lift the knife, you will note it is lighter than an ordinary knife. This is because the knife is so perfectly balanced, that it does not need added weight to help it cut! This balance, in your hand, makes possible an accuracy of cut you have never before known. A certainty of cut quite unique in any cooking experience you may have had.

I make no pretense of low price for this knife. It is not, by any means, the world's most inexpensive knife set. Yet when you consider it as a lifetime investment, its value takes real meaning.

A set of 4 of these knives is $14.98.

Were it to be sold for less, the very qualities that make this knife so supreme, would have to be lessened.

And these knives have been subjected to extreme tests to assure their quality.

A one pound ball has been dropped on this from 6 feet to test the strength of the Rosewood handle.

A weight of 20 pounds was suspended on the blade to test its tensile strength.

A ham bone was used in extensive tests to determine the resistance of the blade to nicking.

In every case, the quality of this remarkable Dione Lucas knife stood firm.

There are four knives in the set. One of 8½" for vegetable paring. One of 11½" for the water thin slicing of bread and such. One of 14¼" for the carving of roasts. And a cleaver of 11" for the separation of chickens and such.

Because this is such a unique ownership, I am including with each set of these knives, four recipes of Cordon Bleu teacher, Dione Lucas, where the use of her knives is quite critical to the outcome of the recipe. (Including her recipe for Supreme de Volaille.)

Remember the truly unique guarantee: **You will never again need to purchase another kitchen knife once you own these.** Should you not be pleased when you see these knives, send them back and we will refund your money.

Save $5.00, regular price $19.98 . . . now $14.98.

DIONE LUCAS
GOURMET CENTERS
Westmoreland Ave., White Plains, N.Y. 10606

5271A

MAIL NO-RISK COUPON TODAY

Dione Lucas Gourmet Centers, Dept. MSC 279
Westmoreland Ave., White Plains, New York 10606

Please send me__________sets of original Dione Lucas Gourmet Knives for only $14.98 plus $1.00 for postage and handling for each set of four. I understand I have a complete money-back guarantee if I am not delighted.

(New York State residents, add appropriate sales tax, please.)

I enclose ☐ check for $________ ☐ money order for $________
or charge my ☐ Master Charge ☐ BankAmericard ☐ American Express

Card Number________________Exp. Date________
Interbank # (Master Charge only)________________
Signature________________________
Name (print clearly)____________________
Address________________Apt. #________
City____________State________Zip________

DIVISION OF BEVIS INDUSTRIES, INC.

beds. Dismayed at the feud, the gentlemanly Leidy, Cope's teacher at the University of Pennsylvania, left vertebrate paleontology for the safety of the microscope and protozoology. Lanham claims Cope and Marsh were the worst haters in the history of science. Yet he concludes, "Men like Cope and Marsh, dragging along the usual fantastic assortment of what are generally called 'human frailties,' but somehow driving implacably toward understanding, show in oversize the lives of us all." I like Lanham's book.

Paul S. Martin
Department of Geosciences
University of Arizona

WHEN YOU WRITE TO NATURAL HISTORY

about a change of address, renewal of subscription, billing, or any kind of adjustment, send the present address label from the magazine wrapper.

Moving? Please notify 6 weeks in advance.
You can use this form to tell us about a move or order a subscription.

Change of address—attach your address label in the dotted area and fill in your new address below, clip and mail to: Natural History Magazine, Membership Services, Box 6000, Des Moines, Iowa 50306.

A new subscription—Check box and fill in name and address below.

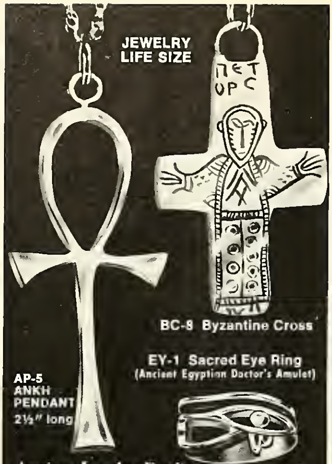
☐ 1 year—$8
☐ 2 years—$15
☐ 3 years—$21

(Add $2 per year
to Canada and other
non-U.S. orders)

Cut your old address label from magazine
wrapper and attach over this area.
Fill in your NEW address below and mail to:
Natural History Magazine
Membership Services Box 6000
Des Moines, Iowa 50306

H001

PLEASE PRINT
Name ______
New Address ______
City ______ State ______ Zip ______


JEWELRY LIFE SIZE
BC-8 Byzantine Cross
EY-1 Sacred Eye Ring (Ancient Egyptian Doctor's Amulet)
AP-5 ANKH PENDANT 2½" long

Ancient Jewelry Replicas
In 14 Karat Gold & Sterling Silver

		Sterling Silver	14K. Gold
AP-5	Ankh Pendant 24" ch.	$27.00	$89.00
BC-8	Byzantine Cr. 24" ch.	29.50	95.00
EY-1	Sacred Eye Ring	25.00	89.00

Rings sized to 11½ no extra cost. • Money back guarantee. Add $1.50 for insured postage. • Orders shipped promptly. • Bankamericard & M.C. for orders $50. minimum.

FREE COLLECTOR'S CATALOG-24 pages picturing over 75 ancient world relics from BC to AD. Plus, catalog featuring over 5D ancient jewelry replicas in precious metals. Satisfy your gift needs today.

MUSEUM AND DEALER INQUIRIES WELCOMED

aladdin house, ltd.
Dept. MJ374 • 648 Ninth Ave. • N.Y. 10036

THE DROLL YANKEES
Phonorecords listed below are 7"
33 RPM, $2 ea., 6 for $10 postpaid

☐ **THE BROOK** Above the delightful rushing sound of a woodland stream we hear birds, a fox and Spring Peepers. Sounds identified on opposite side.

☐ **SONG SPARROW** with a background chorus of Redwings, Green Frogs, and other birds. Sounds identified on other side.

☐ **SPRING MORNING** A walk through the woods and fields. 31 birds identified. On flip side, the bird songs alone.

☐ **SOUNDS OF THE SEA** Surf, gulls and the distant whistles of passing ships. On opposite side, a steamboat leaving port with fog horns and bells.

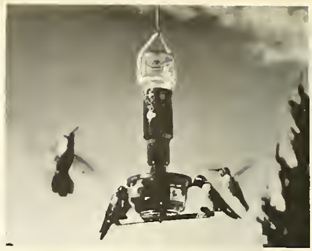
☐ **GREEN MOUNTAIN RAILROAD** For those who love the sounds of steam engines. On side A we ride the rails. On side B we are at the depot as engines come and go.

☐ **BARNYARD ANIMALS** Life on a Vermont family farm with narration by the farmer boy. On side B the animals do all the talking.

☐ **SAPSUCKERS AND FLICKERS** Dr. Lawrence Kilham interprets tappings and calls of Yellow Bellied Sapsuckers and Flickers. The birds alone on Side B.

Write for Catalog of Droll Yankees 12" and 7" records and their bird feeders.

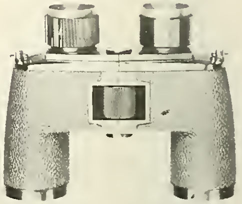
DROLL YANKEES INC
Box 229 H, Barrington, R. I. 02806



FOR HUMMINGBIRDS ONLY!

Hang an original "Hummy-Bird Bar" ® in your garden and watch 'em line up for a treat! Hummers can dine four-at-a-time. (actual photo) Glass bottle with 4-way plastic cup. Detachable perch. Beeproof. No drip or rust. Guaranteed. Instructions. $3.50 plus 50¢ ea. pstg & hdlg. Add 18¢ tax in Calif. Sorry, no CODs. HUMMINGBIRD HEAVEN, 10726-N Samoa Ave., Tujunga, Calif. 91042. Makers of the "Fun Bar" for orioles. Our 18th year. Made in U.S.A.

SHELLS, MINERALS, FOSSILS, INDIAN ARTIFACTS
Send 50¢ for Illustrated Catalog
DOVER SCIENTIFIC
Box 6011 C Long Island City, N.Y. 11106



BUSHNELL 7x35 CUSTOM
Mfg. List $139.50 Postpaid $84.50

This is an example of the deep discount prices on high quality optics that is found in our FREE catalog. This catalog lists and illustrates an outstanding selection of camera lens, telephoto lens, telescopes, binoculars etc., plus valuable information on how to properly select them. Write for it today.

GIL HEBARD OPTICS
COURTHOUSE SQ., KNOXVILLE, ILL. 61448

You don't have to be rich to have a greenhouse!
Write for our catalog.
TURNER GREENHOUSES
Mt. Olive Highway, Goldsboro, N. C. 27530

LIVE IN THE WORLD OF TOMORROW...TODAY!

A BETTER LIFE STARTS HERE

(And our FREE CATALOG is packed with exciting and unusual ecological & physical science items—plus 4,500 finds for fun, study or profit . . . for every member of the family.)

"FISH" WITH A MAGNET

Go treasure hunting on the bottom! Fascinating fun & sometimes profitable! Tie a line to our 3½ lb. Magnet—drop it overboard in bay, river, lake or ocean. Troll it along bottom—your "treasured" haul can be outboard motors, anchors, other metal valuables. 3½ lb. Magnet is war surplus—Alnico V Type—Govt. cost twice our price. Lifts over 40 lbs. on land—much greater weights under water.

Stock No. 70,570E 3½ lbs...$11.50 Ppd.
Stock No. 60,215E 1½ lbs...$6.50 Ppd.

130 EXPERIMENTS IN OPTICS...

and photography! Optix® Experiments Kit is a complete optical & photography lab for 130 exciting experiments. Lets you recreate the periscope, telescope, microscope, kaleidoscope! Build a 35mm reflex camera with interchangeable lens system! Make, develop photographic film! Enjoy the fun and fascination of having your own optics lab. Fully illustr 112-pg manual, 8½x11", clearly explains usage of this stimulating kit's 114 precision engineered components.

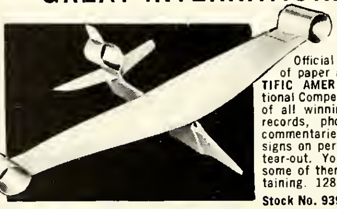
Stock No. 71,646E ....$22.50 Ppd

BUILD A "PRO" WEATHER STATION

Meteorology kit can give you the know-how to check your predictions against official forecasts! Has remote reading anemometer w/windvane. Indoor indicator board flashes neon, shows wind speed, direction. Safety power cord holds current to less than 1 ma. Also: sensitive air-tank barometer w/2-ft. indicator column; sling psychrometer to measure rel. humidity; rain gauge that measures to 1/100th inch; 100 ft. lead-in wire; cloud chart; forecasting manual.

Stock No. 71,022E $17.00 Ppd.

GREAT INTERNATIONAL PAPER PLANE BOOK!



Official fly-them-yourself book of paper airplanes from SCIENTIFIC AMERICAN'S "1st International Competition". Includes plans of all winning entries, time-aloft records, photos, technical data, commentaries. Has 20 unusual designs on perforated pages for easy tear-out. You won't believe how some of them fly! Amusing, entertaining. 128 pages, 9" x 11¾".

Stock No. 9391E .... $2.95 Ppd.

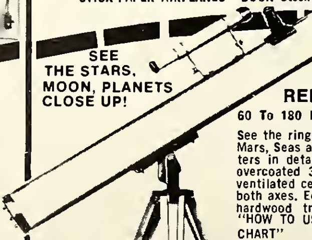
"STICK-PAPER AIRPLANES" BOOK Stock No. 9427E .... $4.95 Ppd.

STEREO MICROSCOPE AT ⅓ PRICE

Mfr.'s surplus! Paired 10x Kellner eyepieces w/rubber eyeguards & paired 3X color corrected objectives for 30X overall. Left side focuses independently. Good definition; collimated; coated optics; long working distance (var. 1½-4"); interpupillary adj: 55-80mm; extends 9-13" overall. Removable diffusing plastic stage; helical rack & pinion for smooth focusing; lockable head swings 360°. Lustra-coated metal, study vibrationless base. 3½ lbs. Imported. Hurry!

Stock No. 71,621E .... $59.50 Ppd.

SEE THE STARS, MOON, PLANETS CLOSE UP!



3" ASTRONOMICAL REFLECTING TELESCOPE

60 To 180 Power. Famous Mt. Palomar Type

See the rings of Saturn, the fascinating planet Mars, Seas and Craters of the Moon, Star Clusters in detail. New improved, aluminized and overcoated 3" diameter f/10 primary mirror, ventilated cell. Equatorial mount with locks on both axes. Equipped with 60x finder telescope, hardwood tripod. Included FREE: VALUABLE "HOW TO USE YOUR TELESCOPE" book; "STAR CHART"

DELUXE 3" REFLECTOR TELESCOPE Stock No. 80,162E $66.50
4¼" REFLECTOR TELESCOPE (45x to 270x) Stock No. 85,105E ....$115.00 FOB
4¼" REFLECTOR TELESCOPE WITH CLOCK DRIVE Stock No. 85,107E ....$149.95 FOB
6" REFLECTOR TELESCOPE Stock No. 85,187E ....$222.50 FOB
6" REFLECTOR W/(ELECTRIC) CLOCK DRIVE No. 85,086E ....$259.50 FOB

ORDER TODAY! COMPLETE AND MAIL

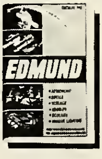
EDMUND SCIENTIFIC CO.
300 Edscorp Building, Barrington, N.J. 08007

How Many	Stock No.	Description	Price Each	Total

PLEASE SEND ☐ GIANT FREE CATALOG "E" MERCHANDISE TOTAL $
ADD HANDLING CHARGE: $1.00 ON ORDERS UNDER $5.00; 50¢ ON ORDERS OVER $5.00
TOTAL $

30 DAY MONEY-BACK GUARANTEE
YOU MUST BE SATISFIED OR RETURN ANY PURCHASE IN 30 DAYS FOR FULL REFUND

NAME ____________________
ADDRESS ____________________
CITY ____________ STATE ____________ ZIP ________
I enclose ☐ check
☐ money order for $____________



MAIL COUPON FOR GIANT FREE CATALOG!

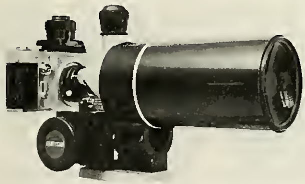
180 PAGES • MORE THAN 4,500 UNUSUAL BARGAINS

Completely new '74 Catalog. Packed with huge selection of telescopes, microscopes, binoculars, magnets, magnifiers, prisms, photo components, ecology and Unique Lighting items, parts, kits, accesories — many hard-to-get surplus bargains. 100's of charts, illustrations. For hobbyists, experimenters, schools, industry.

EDMUND SCIENTIFIC CO.
300 Edscorp Building, Barrington, N. J. 08007
Please rush Free Giant Catalog "E"

Name____________________
Address____________________
City____________State________Zip________

'NO MATTER WHERE YOU LOOK
YOU SEE MORE
WITH A QUESTAR



With Questar Field Model's new Fast Focus the photographer gets those spur-of-the-moment shots—from the eye of a fly to the craters of the moon . . . *instantly!*

GROUND SQUIRREL PICTURES ARE FROM QUESTAR'S NEW BOOKLET CONTAINING 150 NEW PHOTOGRAPHS BY QUESTAR OWNERS: $1 TO COVER HANDLING-MAILING COSTS ON THIS CONTINENT. AIR TO S.A., $2.50; EUROPE AND N. AFRICA, $3; ELSEWHERE, $3.50.

QUESTAR

BOX Q60, NEW HOPE, PENNSYLVANIA 18938

Additional Reading

FLASHING SEA PANSIES (Page 26)

Bioluminescence in Progress. Y. Haneda and F. H. Johnson, eds. Princeton University Press, Princeton, 1966.

Bioluminescence. E. N. Harvey. Academic Press, Inc., New York, 1952.

Light. H. H. Seliger and W. D. McElroy. Academic Press, Inc., New York, 1965.

Chemiluminescence and Bioluminescence. M. J. Cormier et al., eds. Plenum Publishing Corp., New York, 1973.

QUAIL MUSIC (Page 34)

Bird Song. W. H. Thorpe. Cambridge University Press, Cambridge, 1961.

Grouse and Quails of North America. P. A. Johnsgard. University of Nebraska Press, Lincoln, 1973.

Vocal Behavior of Adult California Quail. H. W. Williams. *The Auk*, October, 1969.

Behavior of the Bobwhite, *Colinus virginianus*. A. W. Stokes. *The Auk*, January, 1967.

A GLOBAL IMPERATIVE (Page 41)

Population, Resources, Environment. P. R. Ehrlich and A. H. Ehrlich. W. H. Freeman and Company, Publishers, San Francisco, 1972.

The Closing Circle. B. Commoner. Bantam Books, Inc., New York, 1972.

The Limits to Growth. D. H. Meadows et al. New American Library, Los Angeles, 1972.

A SULTANATE ASUNDER (Page 57)

Oman Since 1856. R. Landen. Princeton University Press, Princeton, 1967.

Unknown Oman. W. Phillips. Lawrence Verry, Inc., Mystic, 1971.

Oman: A History. W. Phillips. Lawrence Verry, Inc., Mystic, 1971.

Oman, Land of Frankincense and Oil. Robert Azzi. *National Geographic*, February, 1973.

RUNNING AND JUMPING (Page 68)

Speed in Animals. A. B. Howell. Hafner Press, New York, 1965.

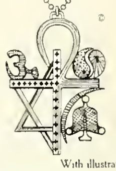
Nature Parade. F. W. Lane. Sheridan House, Inc., Yonkers, 1954.

Animal Facts and Fallacies. O. P. Breland. Harper and Row, Publishers, New York, 1948.

GIANT FULL COLOR WALL CHARTS, 45" x 30", and other graphics.

FREE! Full color catalog available of wall & panel charts, prints of historic ships and London's historic buildings. Accurately detailed, finely illustrated graphics on wide variety of subjects: ANIMALS, FISH, SHAKESPEARE, MUSIC, RACING & VETERAN CARS, SAILING SHIPS—and others. Make the walls of your den, playroom, office interesting, informative and colorful. Write for free color catalog to:

ARTHUR SCHWARTZ/graphics, Dept. NH374
33 Union Square West New York, N.Y. 10003



oneness

A subtle linking of man's religious symbols, delicately wedded together by the artisan.

With illustrated descriptive booklet.
14K with 24" chain $35.00
Sterling Silver $16.75

ISAAC SOLTES DESIGN NH
1923 S. McPherrin Ave.
Monterey Park, Calif. 91754
Check or Money Order/Money-back Guarantee

SUMMER IN THE
WILDERNESS

Climb Adirondack and Big Horn High Peaks.
Canoe voyageur routes in Northern Ontario.
Basic and Advanced Survival Instruction.
Month long Wilderness Expeditions.
Also Weekend/*Custom* Trips: Fall, Winter, Spring
Write for definitive brochure H:
North American Wilderness Survival School
205 Lorraine Avenue, Upper Montclair,
N.J. 07043 Tel: 201-783-7711

BOOK HUNTING?

Virtually any book located—no matter how old or long out-of-print. Fiction, nonfiction. All authors, subjects. Name the book—we'll find it! (Title alone is sufficient.) Inquire, please. Write: Dept. 65.

**BOOKS-ON-FILE
UNION CITY, NEW JERSEY 07087**

ESKIMO ART & ARTIFACTS

Our 40 page catalogue consists of photographs and prices of our current collection of contemporary and ancient Eskimo art and artifacts. The catalogue price is one dollar.

**WALRUS IMPORTS ESKIMO GALLERY
Box 145
Kennebunkport, Maine 04046**

ANTARCTIC STUDY TOUR

Aboard MS LINDBLAD EXPLORER, Dec. 26, 1974-Jan. 20, 1975. Lectures, discussions, shore excursions. University credit. Write Continuing Education, California State University, Los Angeles, California 90032 before May 20, 1974.

ADVERTISING SALES OFFICES

New York:
Central Park West & 79th Stree
New York, New York 10024
212 873-1669

Chicago:
Laurence F. Benson Company
200 East Ontario Street
Chicago, Illinois 60611
312 787-4477

Detroit:
Walter & Fisher Company
Box 484
Bloomfield Hills, Michigan 48
313 332-9241

Miami:
Robert E. Yost
175 South East 25th Road
Miami, Florida 33129
305 854-4214

Los Angeles:
Graves & Associates
4311 Wilshire Boulevard
Los Angeles, California 9001
213 938-2001

San Francisco:
Graves & Associates
670 Ninth Avenue
San Francisco, California 941
415 668-5751

Satellites have taken up where Noah left off.

Mimi Vang Olsen

The Ark may be obsolete, but there's a new way to help preserve the species against flood—and a host of other perils.

It's the watchful eye of the satellite, keeping vigil over our planet and its ecology.

These orbiting sensors see into the ocean depths. They monitor our waterways not only for flood control but for pollution. They check on the health and composition of our forests. They track storms to help curb the threat to life and property.

RCA built the first U.S. weather satellite—TIROS—in 1960. Since then, we've created 78 other successful satellites for a variety of missions. They've logged 60 billion miles in orbit.

And they've grown increasingly sophisticated. Our latest satellites not only stand watch on the global environment, they even take earthly temperatures from hundreds of miles in space. Fittingly enough (because they're named for our customer, the National Oceanic and Atmospheric Administration) the new series is called NOAA.

Electronics is creating new ways to make life better. And RCA, which helped create the technology, is still innovating the electronic way.

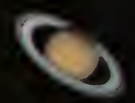
The electronic way

RCA

Celestron®

Multipurpose TELESCOPES

The Celestron 5 and the Celestron 14



Rings of Saturn — Celestron 14

Woodduck at 70' — Celestron 5

The Orion Nebula — Celestron 8

Nature Observers . . . Telephotographers . . . Amateur Astronomers

Study the Eye of a Bee at 20 ft. or a Twirling Galaxy at 2 million light years

Imagine owning a large observatory telescope with a light grasp nearly 200 times that of the unaided eye, yet so portable it can be carried aboard an airplane as hand luggage. That's the Celestron 5. Or imagine owning an even larger telescope, suitable for deep-sky research, that one person can disassemble and load into a compact car in five minutes for a remote star party outing. That's the Celestron 14. What's the secret? Celestron Schmidt-Cassegrain optics. These instruments optically fold the long focal length of a massively stable, large observatory telescope inside a lightweight, compact tube. This means that while you get aperture large enough to produce the bright, detailed images that make high powers worth using, you also get an instrument so portable you'll always take it with you on nature outings or star parties. What's more, the perfectly figured Schmidt-Cassegrain mirror/lens system is capable of sharper images over a wider flat field than any other production telescope — and no other manufacturer offers a Schmidt-Cassegrain of quality comparable to the Celestron.

WHAT SIZE TELESCOPE BEST SUITS YOUR NEEDS?

The Celestron 5 — A briefcase observatory for nature enthusiasts and the world's smallest 5-inch table-top observatory. Study the antennae of a butterfly at 75 ft. Observe or photograph tiny lunar craterlets, the rings of Saturn, brilliant galactic star clusters, the brighter nebulae. Convenient adapters quickly couple most 35mm SLR camera bodies. Tube demounts for hand-held 25X telephoto shots . . . Useful Powers — 25-300X . . . Light Grasp (vs. eye) — 188X . . . Resolution — 0.8 arc sec. . . . Weight — 12 lbs. . . . Base Price — $625.

The Celestron 8 — This most popular of the Celestron line combines the best features of the large-aperture Celestron 14 and the super-portable Celestron 5. Optimum for serious amateur astronomers and the ultimate in telephotography. Inspect the wing structure of an eagle a mile away. Study the polar caps of Mars, the spectra of stars, the filamentary detail of distant nebulae, spiral galaxies . . Useful Powers — 50-500X . . . Light Grasp (vs. eye) — 510X . . . Resolution — 0.5 arc sec. . . . Weight — 23 lbs. . . . Base Price — $895.

The Celestron 14 — The world's largest one-man portable observatory telescope. Ideal for advanced amateurs and science centers. Disassembles in five minutes into components weighing less than 40 lbs. each. Reveals intricate planetary detail, elusive stellar hues in globular clusters, delicate structures of remote nebulae and galaxies. Push-button, hand-held controls . . . Useful Powers — 50-850X . . . Light Grasp (vs. eye) — 1,760X . . . Resolution — 0.28 arc sec. . . . Weight — 108 lbs. . . . Base Price — $3,600.

Information requests promptly filled — write to:

2835 Columbia St., Box 3578H

Phone L.A. (213) 328-9560
N.Y. (212) 834-1888

NATURAL HISTORY

APRIL 1974 • $1

Minolta helps you share the secrets of waiting.

A dreamlike memory and a wistful expression take on much more meaning when you see them together. You can mix time and place, people and landscapes with a little insight and a camera that doesn't hold you back.

You're comfortable with a Minolta SR-T from the moment you pick it up. That is the 35mm reflex camera that lets you concentrate on mood and insight. All the information you want for focusing and exposure is in the viewfinder. With an easy-to-handle Minolta SR-T, the need to make adjustments never comes between you and your picture.

The SR-T 101 lets you use microprism focusing with a ground glass collar. A scale in the viewfinder shows your shutter speed, from 1 to 1/1000th second, plus bulb.

The SR-T 102 gives you split screen focusing with a microprism collar, and adds an aperture readout to the shutter speed scale in the viewfinder. For multiple exposures, the SR-T 102 is equipped with an override that makes it remarkably easy to obtain any number of image overlays.

All Minolta SR-T cameras give you the patented "CLC" through-the-lens metering system. It protects you from under-exposure by automatically compensating in high-contrast light. Meter-coupled Rokkor lenses stay at maximum aperture, so the finder is always at full brightness until the moment of exposure.

When you see something that needs a different perspective, just snap in one of the complete system of Rokkor lenses, from super-wide 16mm to super-long 1600mm, plus zoom and macro lenses. It takes just seconds, with no ASA or f/stop realignment to waste your time.

Try a Minolta SR-T camera. Share your secrets with the world.

For more information, see your photo dealer or write Minolta Corporation, Consumer Products Division, 200 Park Ave. South, N.Y., N.Y. 10003. In Canada: Anglophoto Ltd., P.Q.

minolta
SR-T 102
minolta
SR-T 101
Minolta

Minolta SR-T 102 / Minolta SR-T 101

What happens inside your mind can happen inside a camera.

When identified by a factory-sealed "M" tag, Minolta 35mm reflex cameras are warranted by Minolta Corp. against defects in workmanship and materials for two years from date of purchase, excluding user-inflicted damage. The camera will be serviced at no charge provided it is returned within the warranty period, postpaid, securely packaged, including $2.00 for mailing, handling and insurance.

NATURAL HISTORY

Incorporating Nature Magazine
Vol. LXXXIII, No. 4
April 1974

The American Museum of Natural History
Gardner D. Stout, President
Thomas D. Nicholson, Director

2 Authors

4 Letters

6 Bios: The Specter Behind the Statistics
Arthur W. Galston
Tragically, Malthus was correct.

16 A Tale of Two Travelers
Robert Herendeen
Vacations, like candles, can burn energy at both ends.

21 This View of Life: The Nonscience of Human Nature
Stephen Jay Gould
Biological determinism, in many guises, supports class, sex, and race distinctions.

26 A New Profile for the Wolf
L. David Mech
A contemporary version of Little Red Riding Hood would have a different ending.

32 Evolution under Attack
Norman D. Newell
The struggle between theology and science continues.

40 Comfortable Old Shrines; Divisive New Visions
Jerome L. Mintz
"The appearance of the Virgin is possible—certainly more possible than going to the moon."—A Spanish shoemaker's wife.

48 The Deflowering of Central America
Daniel H. Janzen
A tropical forest needs its busy bees.

54 Celestial Clues to Egyptian Riddles
Gerald S. Hawkins
The computer may help explain the enigma of the Sphinx.

64 A Matter of Taste: Some Like It Hot
Raymond Sokolov

69 Sky Reporter: Atmospheric Titan
Gregory Benford

74 Celestial Events
Thomas D. Nicholson

76 Where and How We'll Grow
A review by Gladwin Hill
Ultimately, all environmental decisions are related to land use.

87 Additional Reading

88 Announcements

Cover: *Like other Egyptian monuments, the Sphinx was carved to face the rising sun. Such astronomical observations offer a deeper understanding of ancient religious thought. Photograph by Elliott Erwitt, Magnum Photos. Story on page 54.*

Alan Ternes, Editor
Thomas Page, Designer
Board of Editors:
Sally Lindsay, Frederick Hartmann,
Christopher Hallowell, Toni Gerber
Carol Breslin, Book Reviews Editor
Florence G. Edelstein, Copy Chief
Karen Bierstedt, Copy Editor
Angela Soccodato, Art Asst.
Diane Pierson, Editorial Asst.
Lillian Gindea
Joyce E. Klutch

Rosamond W. Dana, Publications Editor

Editorial Advisers:
Dean Amadon, Dorothy E. Bliss,
Mark Chartrand, Niles Eldredge,
Vincent Manson, Margaret Mead,
Thomas D. Nicholson, Gerard Piel,
Richard G. Van Gelder

David D. Ryus, Publisher
L. Thomas Kelly, Business Manager
Ernestine Weindorf, Administrative Asst.

Robert E. Williamson, Production Manager

Ann Brown, Circulation Manager
Joan Mahoney
Harriet Walsh

Harvey Oshinsky, Advertising Sales Manager
Gordon Finley
Harry R. Jeter
Vic Asselin
Eileen O'Keefe, Production
Cynthia Dawson, Asst.

Publication Office: The American Museum of Natural History, Central Park West at 79th Street, New York, N.Y. 10024. Published monthly, October through May; bimonthly June to September. Subscriptions: $8.00 a year. In Canada and all other countries: $10.00 a year. Single copies $1.00. Second-class postage paid at New York, N.Y., and at additional offices. *Copyright © 1974 by The American Museum of Natural History. No part of this periodical may be reproduced without the written consent of* Natural History. *Manuscripts and illustrations submitted to the editorial office will be handled with all possible care, but we cannot assume responsibility for their safety. The opinions expressed by authors are their own and do not necessarily reflect the policy of The American Museum.* Natural History *incorporating* Nature Magazine *is indexed in* Reader's Guide to Periodical Literature.

Change of address notices, undeliverable copies, orders for subscriptions, and other mail items are to be sent to Natural History Magazine, Membership Services, Box 6000, Des Moines, Iowa 50306.

NEW GLORY 3'X5'.
We searched the country and found what we think to be the finest U.S. flag made for home use. All nylon with embroidered stars, it comes on a 6', four-section aluminum pole topped by a 5" x 2½" eagle. Wall mount, instructions and flag etiquette folder included. Now, isn't June 14 Flag Day? #2140A **20.00.** (2.40 postage & handling).

From The Horchow Collection
FORMERLY THE KENTON COLLECTION
P. O. Box 34257, Dept. 01921
Dallas, Texas 75234

☐ Please send the new Horchow Collection Catalogue.

CANADIAN WILDERNESS TRIPS

[illegible] you to [illegible] and its [illegible] rivers. All inclusive 10 to 13-day [illegible] holidays feature the Coppermine which crosses the Arctic Circle to recreate Sir John Franklin's journey of 1821; the South Nahanni with Deadmen's Valley and [illegible] Virginia Falls, the historic Athabasca and its famous [illegible]. For the canoeist, [illegible] Wabasca or our beginner's package.

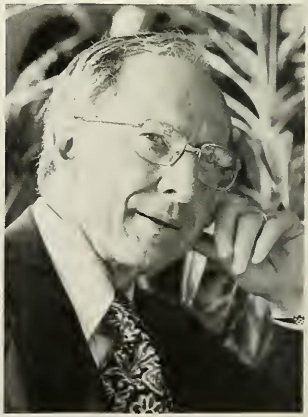
For free brochure write:
NORTH-WEST EXPEDITIONS LIMITED
P.O. Box 1551
Edmonton, Alberta, Canada
T5J 2N7

Authors

Robert Herendeen's decision to measure the energy impact of vacation travel followed his realization that as he "got richer, that is, got a job," he began to think of "more grandiose travel schemes." That study is part of his attempt to quantify the energy costs of all consumer activities. Such documentation, he feels, is a step toward resolving the basic question of whether the goals of affluence and social equity are compatible with environmental quality. Herendeen, who received his doctorate in physics from Cornell University, is research assistant professor at the Center for Advanced Computation at the University of Illinois.

Combining aerial telemetry with ground observations, L. David Mech conducted an intensive study of the spatial organization and population-regulating factors of wolves in the Superior National Forest of Minnesota. This research, begun in 1968, was an extension of earlier ecological work he had done on the wolf packs inhabiting Isle Royale in Lake Superior. His findings are revising a number of conceptions that have long been held about *Canis lupus*. Mech is a wildlife research biologist with the U.S. Bureau of Sport Fisheries and Wildlife.

Norman D. Newell, a geobiologist, has been curator of the Department of Invertebrate Paleontology at The American Museum of Natural History since 1945. He also teaches at Columbia University. Research on historical geology and paleontology has taken him on field trips throughout the United States, to South and Central America, Australia, New Zealand, the Urals, the Middle East, India, Pakistan, Japan, and the West and South Pacific. His work on the rich fossil record of life has shed light on evolutionary principles. Newell obtained his Ph.D. in geology from Yale University after earlier training at the University of Kansas.



"When I get tired of writing, I film, and when I get tired of filming, I write," says anthropologist **Jerome R. Mintz.** He has spent three years doing both in the Andalusian region of Spain (*see* "Trouble in Andalusia," *Natural History,* May, 1972). Mintz first visited the ancient shrine at Alcalá in 1966 and was impressed by the forceful religious paintings on the chapel's walls. Happening upon the new shrine at Palmar de Troyas, he was struck by the sharp contrast in local attitudes toward the old and new shrines. Mintz, currently teaching anthropology at Indiana University, is also completing two books and two films on Spanish peasant society.

Since 1963, **Daniel H. Janzen** has made annual expeditions to Central America to study the ecological interactions of animals and plants in both natural and disturbed habitats. His interest in the subject was aroused when, at the age of seventeen, he went on a butterfly-collecting excursion to Mexico. He has subsequently investigated the causes of extinction of some of the species he once collected. His latest work concerns the remnant lowland deciduous forest in Costa Rica and the complex relationships between such organisms as bees, weevils, and plants. Janzen is an associate professor of zoology at the University of Michigan.

Believing that good food is inevitably the sign of a healthy culture, **Raymond Sokolov** will explore the connections between food and its societal context in a new column entitled "A Matter of Taste." Sokolov, formerly the food editor for *The New York Times,* holds a Bachelor of Arts degree from Harvard, is interested in agronomy and agribusiness, and plans to do a study of the decline of quality in American food production. For relaxation he goes mushrooming and tries his hand at British crossword puzzles.

An astronomer who is also involved in archeology, **Gerald S. Hawkins** has been studying prehistoric and early historic structures for evidence of astronomical knowledge among ancient peoples. He worked first at Stonehenge, where his calculations of the site's alignment with positions of the sun and moon led him to theorize that the megalithic structure was an observatory. He next investigated the desert markings at Nazca, Peru, and the pharaonic temples of ancient Egypt. When not sleuthing around archeological sites, Hawkins is based at the Smithsonian Astrophysical Observatory in Cambridge, Massachusetts. There he studys interplanetary and cosmic dust, the earth's magnetosophere and ionosphere, and solar-terrestrial relationships.

Letters

Origins of Japanese Tattooing

In your article on "The Japanese Art of Tattooing," with its superb illustrations [December, 1973], the author was unclear about the origin of decorative tattooing, which suddenly appeared in Japan during the eighteenth century. The fact that the most popular subjects were drawn from illustrations in a popular Chinese book, that other favorite subjects were the familiar Chinese ones of dragons, carp, and peony flowers, that the red used was a common Chinese pigment, cinnabar (not "mainly lead" as the author stated), all suggest a probable Chinese origin, although the Chinese themselves never practiced tattooing on such a grand scale. The original place from which this art seems to have spread was the port of Nagasaki, where many Chinese people then resided. If some of them introduced the art and passed it on, it would seem that, as with so many other techniques learned from Chinese and Korean craftsmen, the Japanese artisans were more willing to experiment and carried the skill to a much higher degree: in this case, to extremes that the Chinese and Koreans would have considered "very bad taste." The original use of tattooing in Japan, to mark criminals, was definitely borrowed from China.

Schuyler Cammann
Professor of East Asian Studies
University of Pennsylvania

More Inquiry into Madness

"Oscar: An Inquiry into Madness," by Peter J. Wilson [February, 1974], stirred up a lot of memories for me. While serving with the Peace Corps in Malawi (1965–1968), I became acquainted with a man who solved the pressures of cultural conflict in a similar manner. The cultures involved are not the same and the particular history differs, but I think there are enough underlying similarities to make a recounting of his story of interest to those who read the account of Oscar.

The only name I ever knew for this man was Jesus Christ. He insisted strongly that he was indeed Jesus and "above Dr. Banda" (President of Malawi). On one occasion he attempted to "prove" his identity by giving me a shilling. At the time I refused it and argued that if he were really Jesus, he would help someone more deserving. In retrospect, I see that he was symbolically offering charity to a "European," thus demonstrating a sense of superiority. This was in line with his deep insistance that "there is no black, there is no white." The first time I saw him he was haranguing a group of grade school girls on this point. As evidence he pointed out that no one is black like a chalk board or white like a shirt.

He always used excellent English and impeccable logic, yet everyone in the area agreed that he was, indeed, mad. Perhaps I am a bit mad myself, for I enjoyed long conversations with him. Once we spent an afternoon discussing the fact that England has a queen. We both agreed that this was deplorable, but after a while it dawned on me that we arrived at this conclusion from totally opposite routes. He thought it was deplorable that a woman should rule men, while I thought it deplorable that monarchy should still exist, even symbolically.

He was not always "mad." Mr. Sikwese, one of my fellow teachers at the local primary school, had been a schoolmate of his and assured me that "Jesus" was the brightest boy in the mission school. He finished the eighth grade, which, at that time, was a major accomplishment. Even when I knew him he bragged of his education as being superior to mine. (I never corrected him on that point.) After finishing school he left for Tanzania, where he worked on the East African Railway. Even when I knew him he was proud of his job. He showed me the salary he had received and bragged that this was better than I could do. (Again I didn't contradict him.)

I do not know what precipitated it, but "Jesus" returned from Tanzania so completely "mad" that he ran around the village stark naked. Everyone assured me that he had "improved" tremendously by the time I met him.

The religious, social, and racial conflicts that shaped the "madness" of "Jesus" are themselves "mad" in many ways. His problems mirror and illustrate many of the conflicts tearing apart millions of people throughout the world. In this sense, both Oscar and "Jesus" may help us to see many things that we may be too culturally blind to see in "sane" society.

Bruce J. Hargreaves
Department of Preventive Medicine
New York University

Size and Diet

Stephen Jay Gould's fascinating article [January, 1974] about the limits imposed on animals by their size and shape, limits that science fiction moviemakers are unaware of, reminded me of one instance where fantasy obeys biological rules. In the prefatory chapter of the *Annual Review of Physiology*, 1967, physiologist Max Kleiber describes how the Lilliputians's calculation of Gulliver's food needs almost precisely conforms to the relationship that food requirement is proportional to the three-fourths power of body weight. This relationship was discovered by Kleiber in 1932, more than two centuries after Swift wrote his remarkable tale.

George Dale
Department of Biology
City University of New York

For Better Photographs

After seeing your "Photograph Want List" in the February issue I am moved enough to comment: beautiful. It is something that should have been practiced long ago by every publication, and I am very pleased to finally see it in print. I know from my own dealings with fellow professionals and advanced amateurs that there are vast reserves of excellent photographs that accumulate in attics. Many people are "saving" their worthy slides for "the day" when they will be able to get them published. Your want list will spur photographers on to new and better efforts, and that will benefit us all.

Herbert W. Morse
Cincinnati, Ohio

Collect signed works of art by Waterford.®

Hold Waterford to the light and you can see faintly etched the signature that identifies it as an authentic work of art.

Each piece of Waterford crystal is a signed original, made by hand with heart. Born in white hot heat, its sheer brilliance reflects the glory of the distant past.

Every single facet is cut by hand in Ireland, just the way Waterford museum pieces were cut long years ago.

Waterford gathers the light of ten thousand yesterdays to illuminate ten thousand tomorrows.

It is an investment in art that will enchant you now; and reward you and your heirs as it grows in value.

To illustrate a few current works of art:
4½" Vase, $26
Lismore goblet, $11.50.
6" Vase, $27.50.

Write for free full-color booklets. Waterford, 225 Fifth Ave., New York 10010.

Or visit the Waterford Gallery at the important store in your area.

Isn't it time you started collecting signed originals by Waterford?

(And English bone china by Aynsley, to go with it?)

Photo Pes

by Arthur W. Galston

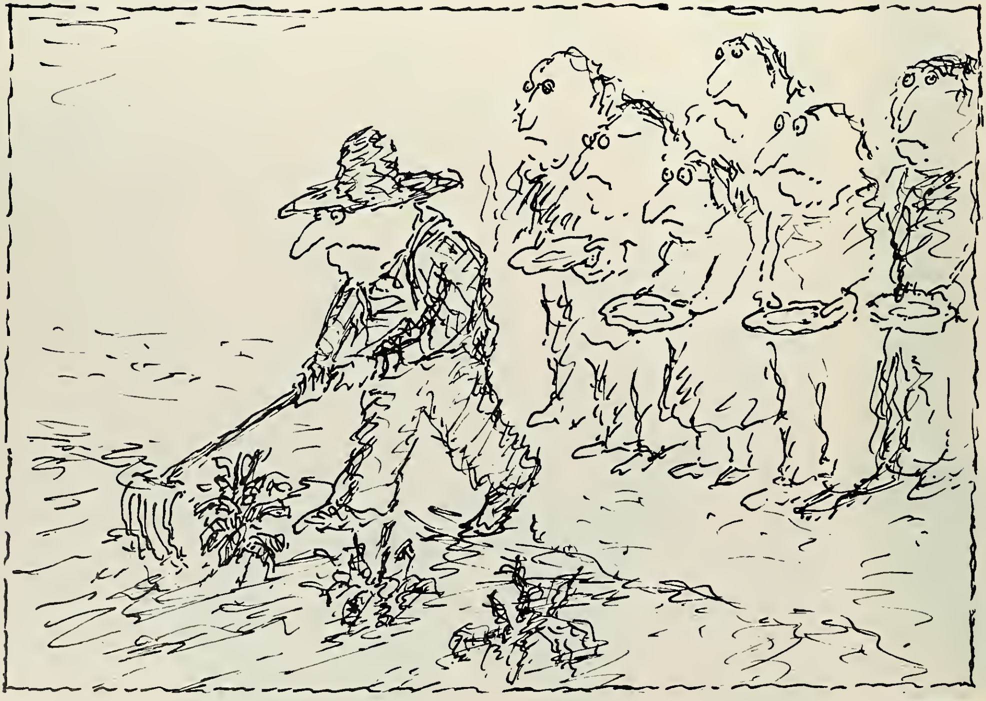
The Specter Behind the Statistics

Unless population growth is controlled, there will not be enough food for the world's hungry billions

The recent political crisis in the Middle East has focused attention on the worldwide energy shortage, which should not have come as a great surprise to anyone. Scientists have been predicting its imminence for many years. They knew that mankind's continually growing and often profligate use of fossil fuels would eventually have caused an energy crisis even without a Middle East war or an Arab oil boycott. Now that the crisis has come, people are more receptive to consideration of rather drastic and possibly Draconian methods to avoid embarrassment or even immobilization in the future.

Scientists' prognoses for the world's food supply have long been similarly Cassandralike. As far back as 1798, an economist named Thomas Robert Malthus pointed out that the arithmetically progressing increase in the world's food supply would ultimately be unable to keep up with the geometrically progressing increase in population. In the twentieth century, enthusiasm for the "quick fixes" provided by modern technologies of fertilizer use, improved seed strains, and pesticides pushed gloomy predictions into the background. But the time to reexamine the matter may be upon us. The recent Club of Rome forecasts, battered though they have been by many experts, have reawakened interest in what could be called the "calorie crunch," so let us consider the future of our food supply in the face of some basic, brute facts.

About 3½ billion people, or about 5 percent of all humans who



EDWARD KOREN

The finest stereo receiver the world has ever known.

We recognize the awesome responsibility of making such a statement. Nevertheless, as the leader in high fidelity, we have fulfilled this responsibility in every way.

Pioneer's new SX-1010 AM-FM stereo receiver eclipses any unit that has come before it. It has an unprecedented power output of 100+100 watts RMS (8 ohms, both channels driven) at incredibly low 0.1% distortion, throughout the entire audible spectrum from 20 Hz to 20,000 Hz. Power is maintained smoothly and continuously with direct-coupled circuitry driven by dual power supplies.

To bring in stations effortlessly, clearly and with maximum channel separation, the SX-1010 incorporates an FM tuner section with overwhelming capabilities. The combination of MOS FETs, ceramic filters and phase lock loop IC circuitry produces remarkable specifications like 90dB selectivity, 1.7uV sensitivity and 1 dB capture ratio.

Versatility is the hallmark of every Pioneer component. The SX-1010 accommodates 2 turntables, 2 tape decks, 2 headsets, 3 pairs of speakers, a stereo mic and an auxiliary. It also has Dolby and 4-channel connectors. There's even tape-to-tape duplication while listening simultaneously to another program source. This is another innovative Pioneer exclusive.

The SX-1010 is actually a master control system with its fantastic array of controls and features. It includes pushbuttons that simplify function selection and make them easy to see with illuminated readouts on the super wide tuning dial. FM and audio muting, hi/low filters, dual tuning meters, loudness contour, a dial dimmer control and a fail-safe speaker protector circuit. Never before used on a receiver are the twin stepped bass and treble tone controls that custom tailor listening to more than 3,000 variations. A tone defeat switch provides flat response instantly throughout the audio spectrum.

By now it's evident why the SX-1010 is the finest stereo receiver the world has ever known. Visit your Pioneer dealer and audition its uniqueness. $699.95, including a walnut cabinet.

U.S. Pioneer Electronics Corp., 75 Oxford Drive, Moonachie, New Jersey 07074.
West: 13300 S. Estrella, Los Angeles 90248 / Midwest: 1500 Greenleaf, Elk Grove Village, Ill. 60007 / Canada: S. H. Parker Co.

PIONEER®
when you want something better

PIONEER STEREO RECEIVER MODEL SX-1010
FM
AM
POWER
PHONES
BASS
TONE
TREBLE
TAPE
DUPLICATE
MONITOR
ADAPTOR
MIC
AUX
MONO
LOUDNESS
BALANCE
RIGHT
VOLUME
MAX
MIC
L
R

FLY THE AFRICAN EXPRESS.

It's New York to Dakar non-stop.
It's the greatest way to the last great continent.
It's Air Afrique. The African airline that knows Africa best.

Air Afrique's African Express jet adventures-off from Kennedy every Saturday at 6 P.M. Its destination: Dakar, and then on to Robertsfield/Monrovia, Abidjan, Lome, Douala, Libreville, and Kinshasa.

But Africa begins in the sky on Air Afrique. Our food is the finest African cuisine. Our stewardesses are dressed in magnificent native fabrics (one of Africa's finest arts). And our friendship is just a hint of what you'll find when you land.

Discover Africa. Our coupon can bring you closer. Our African Express can bring you there.

AIR AFRIQUE
Air France, General Agent. Box DC8
New York, N.Y. 10011
Please send me information about
Air Afrique's Africa immediately.
Name____________________
Address____________________
City__________State__________
Zip__________Phone__________
Travel agent____________________
Or call any Air France office: RK-NH-4-74

Air Afrique's fleet now features DC-10's clean-powered by General Electric jet engines.

have ever lived, inhabit the earth today—awesome statistical testimony to the rapidity of human population growth in the last several hundred years. This population increase stems from a lowered death rate as well as a higher birthrate; both reflect improvements in public health procedures as well as in food production. Paradoxically, the rate of population increase is lowest in the developed countries, which can best afford to assimilate increases, and highest in the underdeveloped areas of the world, which cannot. The over-all average population increase is between 2 and 2½ percent per year; in developed countries like the United States, the Soviet Union, the Western European nations, and Japan, however, the rate falls well below the average, somewhere between 1 and 1½ percent. Except for Japan, Asia has about a 2 percent rate; South America, Africa, and the Middle East, between 2½ and 3 percent; and Central America has a rate in excess of 3 percent. These differences arise from various effects of industrialization on culture, which range from the dwindling need for abundant manpower to the de-emphasis of family life, and which include the developed nations' ability and determination to introduce birth control techniques into the general population.

The over-all rate of increase of between 2 and 2½ percent indicates that humans will produce this year more than seventy million new mouths to feed, or a population larger than that of France. Clearly we cannot afford an increment of this size to be added to the earth each year. At the present rate, the doubling time for the earth's population would be about thirty years. If the rate were maintained until about the year 3000, there would be 10^{23} people on earth. Students of chemistry will immediately recognize this figure as approaching Avogadro's number—the constant number of molecules in one gram-molecule, or mole, of any substance, as calculated by the nineteenth-century Italian physicist Amadeo Avogadro. And so, in the year 3000 the earth would have roughly Avogadro's number, or one mole, of people. If we allow a weight of 100 pounds per person (certainly a conservative estimate), the total weight of humanity on

Australia is a land apart. Good thing, too. Or we wouldn't have Kookaburras, Kangaroos, Koalas, and a whole lot of other things you can only find Down Under.

Go to Melbourne's Royal Botanical Gardens, they're the finest in Australia. Visit the Sir Colin Mackenzie Sanctuary where the Platypus was first bred in captivity (that's that funny, furry, duck-billed creature that's actually a living fossil).

On Phillip Island see thousands of Fairy Penguins, the world's smallest. Be a guest at a hundred-year-old homestead. The owners are noted bird-watchers and they'll give you the drum* on our feathered mates. Laughing Kookaburras. Gallahs that flit about like tiny Charlie Chaplins (we Aussies call bad drivers "mug gallahs"). Willy Wagtails. Butcher-birds. Masked Owls. And outlandish kinds of parrots.

In Canberra go to the Tidbinbilla Nature Reserve. All sorts of Kangaroos, lots of them carrying their joeys*. Not to mention Swamp Wallabies, Ring-tailed Possums, Emus (those big silly birds that can't fly a lick), shy bush animals.

In Sydney take a ferry to the Taronga Zoo Park and Aquarium. Inside, fantastic water and wildlife. Outside a bonzer* harbor view, with Sydney's hundred-million-dollar Opera House looking like a mammoth space-age sailboat.

See the Koala Sanctuary in Brisbane. 150 cute slow-pokey Koalas, and cuddling is encouraged. And while you're there visit jungly Lamington National Park. Over 500 waterfalls, orchids thick as weeds, Lyrebirds (if you're lucky you can catch one in a courtship dance).

Naturally, you won't just be taking in our flora and fauna; you'll be enjoying our fine tucker*, and having a good drop* with us Aussies. We're a rare species, too. Don't know how to be unfriendly, so very quickly you become our mates. It'll be a beaut trip.

Just mail in the coupon and we'll tell you more about our reasonably-priced prepackaged wildlife tours. Of course, if you prefer an individual tour, your Travel Agent will gladly plan one for you.

*__The Drum__/the truth *__Joey__/baby kangaroo *__Bonzer__/great *__Tucker__/food *__Good Drop__/drink

Australian Tourist Commission Dept. N
1270 Avenue of the Americas, N.Y., N.Y. 10020
3550 Wilshire Blvd., Los Angeles, Calif. 90010

Already I'm wild for Australia's wildlife.
Please send me literature on
☐ Birds ☐ Flora ☐ Fauna
I'm interested in ☐ Group Tours
☐ Individual Itineraries

Name ____________________

Address ____________________

City ________ State ________ Zip ________

AUSTRALIA Where the good old days are now.

Dare a little.
Soak up the midnight sun. Spy on a kittiwake, sail through Eskimo Country on the new M/V Bewa Discoverer.

It can happen this July. You can visit Viking discoveries. Fish waters swarming with salmon. Take a helicopter to ice floes. Navigate the narrows, coves and inlets that filigree the coast of Greenland.

And it can happen aboard a ship as rare as the places it takes you to. The new pleasure-expedition ship M/V Bewa Discoverer, complete with helicopter; fishing station; a duplicate bridge with navigational equipment for you to study; a passenger to officer intercom system; and a special complement of scientists to help you bone up on everything from kittiwake birds to vanished indian tribes to the eskimos up there on the rim of the Arctic Circle.

All this *plus* all the pleasureful trimmings of conventional luxury liners. Your expedition cruise leaves July 8th from New York and arrives 24 days and countless memories later in Thule. It's the third of nine M/V Bewa Discoverer cruises to "inaccessible places," all offered exclusively by Thomas Cook, the largest travel organization in the world. Ask your travel agent for our brochure, or send us the coupon below.

Thomas Cook
WORLD TRAVEL SERVICE

Thomas Cook
587 Fifth Avenue
New York, New York 10017
BEWA CRUISES NH2

Gentlemen: Please send your brochure giving complete details on the new M/V Bewa Discoverer Pleasure Expedition Cruises.

Name________
Address________
City________
State________ Zip____
My Travel Agent is________
M/V Bewa Discoverer is registered in Denmark.

world famed
GOSSEN
Luna-Pro®
SYSTEM CdS REFLECTED and INCIDENT LIGHT METER

It's every kind of exposure meter you'll ever have to buy!

Just by itself, the Luna-PRO — with its extraordinary 2,000,000:1 sensitivity range—is the world's outstanding meter for reflected and incident light . . . brightest sunlight . . . candlelight . . . even moonlight!

To make it a SPOT METER, ENLARGING METER or MICROSCOPE METER is a matter of seconds with the optional lock-on attachments. The Luna-Pro is the only meter you'll ever have to buy!

SPECIFICATIONS: One-hand operation ▪ Measures reflected and incident light (with built-in hemispheric diffuser) ▪ For still and movie cameras ▪ 30° light acceptance angle ▪ single selector button for high and low range ▪ Automatic "memory" needle lock ▪ ASA 6 to 25,000; f/1 to f/90; 1/4000th sec. to 8 hours; Cine from 8 to 128 fps ▪ EV − 8 to EV+24; .016 to 32,000 foot candles ▪ Weighs only 7 ounces.

OPTIONAL ATTACHMENTS

VARIABLE ANGLE "Spot Meter" ATTACHMENT
MICROSCOPE ATTACHMENT
ENLARGING ATTACHMENT

At better camera stores or write for color brochure
KLING PHOTO COMPANY
P.O. Box 1060, Woodside, N. Y. 11377
Berkey

earth by that time would be 10^{25} pounds, or the weight of the earth itself. It therefore surely seems that man's reproductive rate must diminish in the near future.

All food on earth originates in the process of green plant photosynthesis, by which carbon dioxide from the air and water from the soil are combined in the presence of radiant energy from the sun and converted into carbohydrate and other organic materials in the green leaf. It is estimated that about 200 billion tons of carbon are fixed in this way each year. This amount of carbon would yield about 500 billion tons of carbohydrate. Each day of the year, photosynthesis accordingly stores for us the equivalent of about 1.4 billion tons of sugar. In order to relate that figure more closely to food supplies, let us calculate first the caloric equivalent of one ton of sugar. One ton equals 2,000 pounds, which multiplied first by the 454 grams in one pound and then by the 4 calories yielded by burning one gram of sugar gives a total of about 4 million calories per ton of sugar. Multiplying 1.4 billion tons per day of sugar by the 4 million calories per ton of sugar reveals the daily value of photosynthesis as being about 5.6×10^{15} calories.

How many calories do the 3½ billion people on earth need each day? Based on an average requirement of approximately 2,500 calories per person per day, the total daily caloric need of mankind is 8.75×10^{12}. Roughly, therefore, the 1.4 billion tons of sugar stored by photosynthesis each day equals about 700 times the number of calories required by all humans for food. Such a comfortable safety factor would seem to indicate that humans could go on reproducing for some time before confronting severe nutritional shortages, but this would in fact be a misleading conclusion.

For one thing, an enormous portion of the earth's total photosynthesis, somewhere between 50 and 90 percent, occurs in the ocean, much of it in microscopic marine algae. Let us use the more conservative, and thus more optimistic, figure of 50 percent. If we had the ability to filter or centrifuge out the entire volume of the ocean, we could harvest all this material and presumably convert it into

Imagine a land where you can inhale the perfume of pine beside a roaring waterfall.

Cup your hands and drink deeply from a crystal-clear creek. Discover the strange mystery of mist-shrouded Forbidden Plateau. Imagine a land where you can breathe the incense of salt, cedar and seaweed on a forgotten stretch of beach.

Imagine a land where you can stroll through an English city where flowers bloom the year round. Experience a metropolis on a harbour rimmed by towering mountains you can hike on in Summer and ski down in Winter, a metropolis where you can walk in a thousand acre park just minutes from elegant hotels.

Drive through orchards that are frothy white in Spring and crimson red in Fall. Savor the Summer taste of cherry cider from a roadside fruit stand. Take in a rodeo. Discover a ghost town.

Imagine a land of seacoast. Mountains. Lakes. Rivers. Rangeland. Desert. Wheatfields.

Imagine a vacation you'll return from with a thousand faces indeliby impressed on your mind and in your memory.

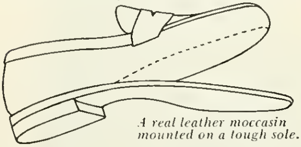
This is British Columbia, Canada.

After visiting British Columbia, stop off at the B.C. Pavilion at the Spokane World's Fair. See your travel agent for information on all-inclusive package tours or write the Department of Travel Industry, 1019 Wharf Street, Victoria, B.C., Canada, V8W 2Z2.

Bass Weejuns . . .
for 30 years, a standard of comfort and good looks.

The classic loafer for men and women . . .

The style of the Bass Weejun® hasn't changed since its introduction over 30 years ago. The reason is obvious . . . it's still the most popular shoe of its kind on the market. You'll find Weejuns incredibly comfortable, and you can be sure they won't go out of style. We think every pair of feet deserves at least one pair of Weejuns!



A real leather moccasin mounted on a tough sole.

Real moccasin comfort in a good-looking loafer.

The Weejun is actually a fine leather moccasin, hand-mounted on a long-wearing sole and heel. The moccasin is made as one piece and meticulously shaped to form a smooth, even cradle under your foot. You get the comfort of a good-fitting moccasin, plus the style and strength of a dress loafer.

Fine quality leather, hand-sewn where it should be.

Only the highest grade leather and finest man-made materials go into each pair of Weejuns. Machines are used where possible, but only experienced hands can achieve the precision Bass demands.

An outstanding shoe value!

You'll wear your Weejuns often with both dress and casual clothes, and they'll last you a good many years. Very few shoes give you this kind of comfort and good looks. And considering all the use and enjoyment you'll get out of them, we think they're priced surprisingly low.

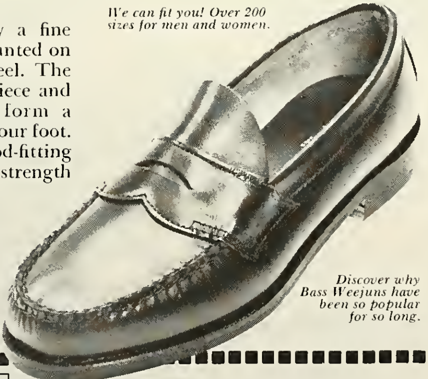
No compromise in sizes.

We offer Weejuns in over 200 different sizes. Just see the correct chart below and indicate your size and width. Color: Rich brown.

No. 2430 (men's) . . . . . . $27.00 ppd.

No. 2439 (women's) . . . . $21.00 ppd.

We can fit you! Over 200 sizes for men and women.



Discover why Bass Weejuns have been so popular for so long.

Norm Thompson Dept. NH-A, 1805 N.W. Thurman, Portland, Ore. 97209

Call toll free anytime (800) 547-6712

Name__________

Address__________

City__________

State__________Zip__________

☐ Check enclosed. Charge to my:

☐ BankAmericard. ☐ Master Charge.

Please include all raised letters and numbers:

Card #__________

Signature X__________

☐ **FREE! Send NEW 40-pg. color catalog of unique spring clothing and equip.**

Weejuns	Size	Width	Qty.
Men's			
Women's			

MEN'S SIZES:

	5	½	6	½	7	½	8	½	9	½	10	½	11	½	12	½	13	14	15
AAA							x	x	x	x	x	x	x	x	x	x	x	x	
AA					x	x	x	x	x	x	x	x	x	x	x	x	x	x	
A			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
B	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
C	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
D	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
E	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
EE			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
EEE			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	

WOMEN'S SIZES:

	4	½	5	½	6	½	7	½	8	½	9	½	10	½	11
AAA			x	x	x	x	x	x	x	x	x	x	x	x	x
AA	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
A	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
B	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
C	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

some usable form of energy, but such an undertaking would expend more energy than it would yield. As it is, we realize only a very small fraction of what the ocean could potentially yield. We depend on the ocean food chain in which 130 billion tons of microscopic algae, the phytoplankton, are eaten by small animals, the zooplankton, which are consumed by pelagic fish, like herrings, sardines, and anchovies, which are in turn eaten by large fish, like tuna, which humans catch and eat. At each of these feeding interfaces the efficiency is about 10 percent, so that of the roughly 250 billion tons of carbohydrate made by ocean photosynthesis each year, we wind up with only 66 million tons of fish and about 700,000 metric tons of edible seaweed.

Although there are some optimistic and ambitious projects for increasing the yield from the ocean, significant improvements in the present yield seem distant and illusory. The most important fishing country in the world, Peru, depends on the upwelling of the Humboldt current to deliver to the surface waters the nutrients so essential to the growth of microscopic algae on which anchovies feed. When, as in recent years, this current becomes less dependable than usual, the fish catch declines precipitously. Because of their high protein content (20 percent), the anchovies caught off Peru are used chiefly to produce fish meal, a major poultry and animal feed. When this material is not available, other sources of protein, such as soybeans, must be employed for stock feeding. The current soaring price of a bushel of soybeans is mute testimony to the widespread effects of a change in nature.

The possibility of improving food production on land, too, has tended to be exaggerated in recent years. About one acre of farmland and one acre of grazing land are being worked on the average to produce the food needed for each individual on earth. Virtually all the prime land of the earth is thus currently given over to agriculture, and the cultivation of additional virgin lands would require heroic measures. Nevertheless some of them could be accomplished. For example, the introduction of water into arid zones could lead to untapped sources of productivity. If

COME ADVENTURING!

A Natural History of GIRAFFES
OCEAN WORLD
C. P. Idyll, Editor
THE SIXTH SENSE OF ANIMALS
Maurice Burton
A Guide to Kenya and Northern Tanzania
FOOD IN HISTORY
REAY TANNAHILL

Spend a little time with some charming — but very quiet — friends.

Come. Discover the exotic life underwater . . . perhaps the world of the future.

Discover the strangely psychic powers of some not-so-strange creatures . . .

Take a trip to lands where lions prowl, kudus roam . . . and anything can happen.

Enjoy some odd menus from Ur of the Chaldees, ancient Egypt, and other out-of-the-way eating places.

All the worlds of man and nature await you in the

Natural Science Book Club

It's high, wide, wild adventure all the way as a member of the Natural Science Book Club. Wonderful reading. Amazing savings. A stamp is all it takes to see your first three books. Why not send it and come adventuring with us!

32720. AMATEUR ASTRONOMY. *Patrick Moore, F.R.A.S.* Basic equipment, important techniques and a guide to the heavens — from asteroids to zodiacal lights. **$6.95**

47340. EXPLORING THE OCEAN WORLD: Revised and Expanded Edition. *Edited by C. P. Idyll.* The non-professional's ideal introduction to oceanography. Leading scientists explain continental drift, marine ecology, exotic underwater life, man's future in the sea. Richly illustrated. **$14.95**

63820. A NATURAL HISTORY OF GIRAFFES. *Text by Dorcas MacClintock. Illustrations by Ugo Mochi.* If you loved artist Ugo Mochi's sensitive silhouettes for *Hoofed Mammals of the World*, you'll love this perceptive and informative study of the members of the giraffe family. **$5.95**

55561. THE INSECT SOCIETIES. *Edward O. Wilson.* "For anyone, layman or specialist, interested in a single, concise, lucid, and authoritative account . . . *The Insect Societies* is the best available and will be for many years."—*Natural History. Counts as 2 of your 3 books.* **$20.00**

52080. A GUIDE TO THE MEDICINAL PLANTS OF THE UNITED STATES. *Arnold and Connie Krochmal.* The definitive work on medicinal plants and their uses. Will show you how to identify them, collect them, and even raise them. Profusely illustrated. **$12.50**

88120. YELLOWSTONE: A Century of the Wilderness Idea. *Ann and Myron Sutton.* A lavish celebration — in evocative words and breathtaking photographs (72 of them in color) — of deer, bison and bears, awesome canyons, the spectacular lakes and forests of this great century-old national park. *Counts as 2 of your 3 books.* **$25.00**

86070. WANDERING LANDS AND ANIMALS. *Edwin H. Colbert.* A bold and original epic history of our planet's drifting continents and the spread of animals through the ages. **$12.50**

50281. GIANT REPTILES. *Sherman A Minton, Jr., and Madge Rutherford Minton.* A storehouse of information of the giant reptiles of the world — the crocodiles and alligators, the giant tortoises of the Galapagos and Aldabra islands, the sea turtles, the dragon lizards of Komodo, and the giant boas and pythons, and more. Illustrated. **$9.95**

32980. AMERICA'S CAMPING BOOK. *Paul Cardwell, Jr.* The most complete guide to camping ever published. Covers equipment, camp housekeeping, sports and hobbies, survival, make-it-yourself instructions and blueprints. Nearly 600 pages with lucid diagrams and drawings. **$10.00**

52050. A GUIDE TO KENYA AND NORTHERN TANZANIA. *David F. Horrobin.* A vicarious, thrilling armchair trip to East Africa. Comprehensive and up-to-date guidebook that contains more than 300 pages with 48 handsome photographs in full color. **$12.50**

78390. THE SIXTH SENSE OF ANIMALS. *Maurice Burton.* Carefully probes the scientific breakthroughs that have occurred in the past twenty-five years to convincingly argue that many animals have not five, but six, seven, and maybe even eight senses. **$6.95**

48700. FOOD IN HISTORY. *Reay Tannahill.* Pioneering work drawing on archaeology, biology, economics, medicine, and other disciplines to show how diet and eating habits have shaped man's development. Lavishly illustrated. **$15.00**

38200. CITY OF THE STARGAZERS: The Rise and Fall of Ancient Alexandria. *Kenneth Heuer.* Sweeping panorama of the supreme center of ancient culture — Alexandria — where for a thousand years philosophy and science flourished. More than 50 drawings, maps, photos. **$7.95**

85960. IN THE WAKE OF THE SEA-SERPENTS. *Bernard Heuvelmans.* Builds a *scientific* case — that the legends of the Great Sea-Serpent have their origins in "chance sightings of a series of large sea-animals that are serpenti-form in some respect." A spell-binding scientific detective story. **$10.00**

52170. HANDBOOK FOR PROSPECTORS. Fifth Edition. *Richard M. Pearl.* Completely revised and updated, for hikers, campers, weekend rockhounds as well as the serious mineral prospector. **$14.50**

HOW THE CLUB OPERATES • The Book Club **News,** describing the coming Main Selection and Alternate Selections, will be sent to you 15 times a year at three to four week intervals. • If you wish to purchase the Main Selection, do nothing and it will be shipped to you automatically. • If you prefer one of the Alternates, or no book at all, simply indicate your decision on the reply form always enclosed with the **News** and mail it so we receive it by the date specified. • The **News** is mailed in time to allow you at least 10 days to decide if you want the coming Main Selection. If, because of late mail delivery of the **News**, you should ever receive a Main Selection without having had the 10-day consideration period, that Selection may be returned at Club expense. • After completing your trial membership, you will be entitled to take advantage of our fabulous bonus plan which offers savings up to 70% and more.

Take any 3 books

(values to $44.95)

for only 99¢ each

if you will join now and take only 3 more books—at most welcome discounts—in the next 12 months.

(Retail prices shown)

56530. ISLAND AT THE CENTER OF THE WORLD. *Father Sebastian Englert.* Easter Island's mysterious giant statues, the islanders' puzzling past, their lost language — new light is shed on them all here. Lavishly illustrated in full color. **$15.00**

35751. BEGINNER'S GUIDE TO ARCHAEOLOGY. *Louis A. Brennan.* The techniques and background information that will enable anyone to find, survey, test, excavate, preserve, analyze and record artifacts and other evidences of prehistoric life. Includes state by state lists of existing sites and restorations. **$9.95**

Natural Science Book Club 4-81A
Riverside, New Jersey 08075

Please accept my application for membership and send me the three volumes indicated, billing me only 99¢ each. I agree to purchase at least three additional Selections or Alternates during the first year I am a member, at special members' prices. Savings range up to 30% and occasionally even more. My membership is cancelable any time after I buy these three books. A shipping and handling charge is added to all shipments.

Send no money. Members are billed when books arrive.

3 books for 99¢ each

Indicate by number the 3 books you want.

☐ ☐ ☐

Some expensive books count as 2 selections.

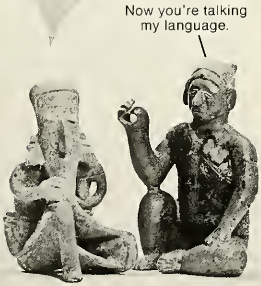
Name______________________

Address______________________

City
State______________ Zip__________

(Offer good in Continental U.S. and Canada only. Prices slightly higher in Canada.)

KAHLÚA
Licor de Café
COFFEE LIQUEUR
PRODUCT OF MEXICO
KAHLÚA S.A.



KAHLÚA®
Black Russian. What an intriguing idea.

A mood in a glass. An ounce of Kahlúa, two ounces of vodka, rocks. Superb. Before or after anything.
The Kahlúa Recipe Book is yours for the sending. Because you deserve something nice.

Kahlúa, Coffee Liqueur from Sunny Mexico.
53 Proof, Jules Berman & Assoc.,
116 No. Robertson Blvd., Los Angeles, Calif. 90048

safe nuclear plants could be built, then presumably entire areas of the Arctic, now too cold for agriculture, could be brought into production. But the chances seem slim that even these measures could keep up with the press of the world's population growth.

Our best bet for the immediate future would therefore seem to involve improved production on existing farmlands. This possibility depends on the future development of a combination of three agricultural technologies: better genetic strains of crop plants, better attention to their nutritional needs so that their productivity potential can be fully realized, and better protection against diseases and predators that tend to diminish the over-all yield of the crops.

In looking at these three aspects of food production, let us note first that in addition to 2,500 calories per day, each individual daily requires small quantities of specific mineral salts, a certain number of vitamins, and a fraction of an ounce of eight of the twenty amino acids that build proteins. Of the total world amount of protein, about 50 percent comes from cereal grains, especially wheat and rice. These crops contain on the order of 5 to 13 percent protein, but this source of protein does not necessarily provide all the essential amino acids required. Pure vegetable diets based on these grains must be supplemented with some animal proteins or synthetic amino acids to be completely satisfactory from a nutritional point of view. But while animal proteins are thus necessary, they are also wasteful. For example, it takes about three pounds of grain to produce one pound of poultry, about five pounds of grain to produce one pound of pork, and about ten pounds of grain for one pound of beef. Theoretically, the world would be better able to meet human nutritional needs if all of us ate only vegetable matter, properly supplemented with minute quantities of the eight essential amino acids, which we could easily obtain by synthesis or microbial fermentations.

The impact of genetics on crop yield is probably best illustrated by the story of hybrid corn. In 1933, before the introduction of hybrid corn, about 22.6 bushels per acre were produced on the average in the United States. By 1943, when half of all the corn grown in the United States was hybrid, the average yield had risen to 33.2 bushels per acre; and by 1963, when 95 percent of all the corn was in hybrids, the yield had reached 67.6 bushels per acre. At the same time that the higher-yielding hybrids were being introduced, the need for chemical fertilizers rose sharply. In 1943 only 28,000 tons of fertilizer were applied to cornfields of the United States, but by 1963 the figure had soared to 821,000 tons.

No matter how good its genetic background, a crop does not attain optimal production unless it receives optimal supplies of nutrient elements, chiefly nitrogen, potassium, and phosphorus. Each year every acre of corn depletes the soil of about 200 pounds of nitrogen, 130 pounds of potassium, and 30 pounds of phosphorus, all of which must be replaced if the yield is to be maintained. This explains in part why the so-called miracle rice strains introduced so optimistically into Philippine agriculture have created problems as well as promise. Without massive quantities of fertilizers, major increases in yield cannot be effected, and in most Asian countries these massive quantities of fertilizer are simply not available.

Well-fertilized, high-yielding crop strains grow rapidly and are extremely succulent. They make an inviting target for myriad potential plant pathogens, such as bacteria, fungi, insects, and nematodes, and suffer competition from weeds. In the United States the estimated annual loss due to these pests is about $11.2 billion per year in the field, which must be augmented by another $2 billion lost in storage, mainly to rodents. Combating these losses has prompted the rapid development of the third necessary agricultural technology—pesticides. Between $2 billion and $3 billion per year is currently being spent on pesticides in the United States. By 1975 it is estimated that the value of pesticides will exceed the total value of fertilizers—a rather amazing prediction since pesticides are generally applied in fractions of a pound per acre, while fertilizers tend to be applied in fractions of a ton per acre. Of all the pesticides, herbicides are now the most important. Their use has been mounting by about 20 percent per year, and their value now stands somewhere between 5 and 10 percent of the total value of the farm crop.

Although pesticides have rightly become the target of many people interested in preserving a balanced ecosystem, they clearly cannot be abandoned altogether. Such an action would lead immediately to an even more critical food situation than we now face, which entails approximately two-thirds of the world's population being inadequately fed. The use of new genetic strains with vast fertilizer requirements and rapid rates of growth makes it mandatory that food plants be protected with pesticides. Some of them do their job well, are reasonably specific, and are rapidly degraded by microorganisms in the soil. That is as it should be. Others, like DDT, produce broad-spectrum results, cannot be rapidly degraded, and accumulate each year into a global pollutant. Such pesticides should be used only when absolutely necessary, as when satisfactory alternatives are not available. Solutions will be found through scientific investigations directed at increasing the desirable qualities of pesticides, minimizing their harmful side effects, and developing strains of plants having improved resistance.

All things considered, the calorie crunch seems bound to worsen rather than to diminish. Unbridled population increase must be brought into check, for even if agricultural scientists were able by some sudden miracle to double food production, this gain too would be wiped out within one generation at the present rates of population growth. Ultimately, perhaps the best hope for increased food yields is to somehow improve the efficiency of green plant photosynthesis, which is only about 2 percent in terms of conversion of incident radiant energy into foods. But that solution, as we have discussed in an earlier article (*Natural History*, October, 1973) also has its intractable problems making for slow progress. Unless the world develops and implements comprehensive plans based on all these facts, we will be confronted with an even more critical food shortage.

Columnist Arthur W. Galston teaches biology at Yale University.

Nobody knows the world like Holland America.
And no ship sails it like the s.s. Rotterdam.

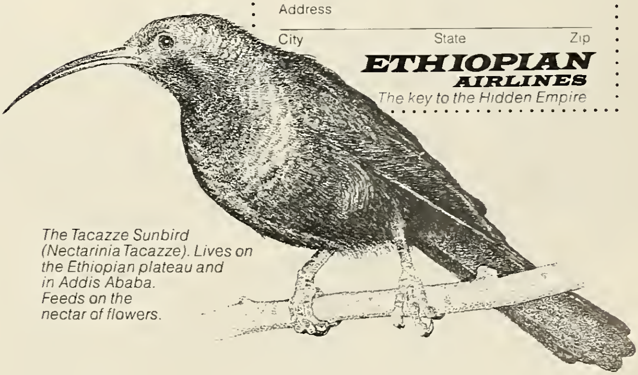
Announcing
our 16th World Cruise
Jan. 18 from New York. (from Ft. Lauderdale Jan. 20).
87 days, 31 ports, the s.s. Rotterdam.
The ultimate travel experience aboard a truly magnificent ship. Visit Rio de Janeiro, Capetown, Bombay, Singapore, Hong Kong, Honolulu, Acapulco and 24 more. $5475 to $16,545.
See your travel agent or call Miss Martin collect at (212) 620-5101, toll-free at (800) 221-6657.
Holland America Cruises, Pier 40 North River, New York, N.Y. 10014.
Please send brochure on the s.s. Rotterdam 1975 World Cruise.
Name________
Address________
City________ State________ Zip________
Travel agent________
The s.s. Rotterdam is registered in the Netherlands Antilles. Rates per person, double occupancy, subject to availability.
160-WC-4

You may never want to get off.
Holland America Cruises

There are 23 species of birds you'll never see unless you come to Ethiopia.

Birds are safe here because Ethiopia has been the Hidden Empire for 4000 years. We have over 830 different kinds of birds. You might even discover a new species. Call your travel agent. Or mail coupon for facts about our birds and bird-watcher's flights.

ETHIOPIAN AIRLINES 200 E. 42nd Street, Dept. HN-12
New York, N.Y. 10017 Tel. (212) 867-0095
Name
Address
City State Zip
ETHIOPIAN AIRLINES
The key to the Hidden Empire



The Tacazze Sunbird (Nectarinia Tacazze). Lives on the Ethiopian plateau and in Addis Ababa. Feeds on the nectar of flowers.

A Tale of Two Travelers

If Jack Muir backpacks and Manny Watts trailer camps, whose vacation consumes more energy?

by Robert Herendeen

I recently asked an Amish farmer in Sullivan, Illinois, where he vacations. "Vacation? What I want is right here." He is the only person I know who doesn't want to travel. Colleagues, friends, students—all value their mobility. This past summer a co-worker backpacked in Glacier National Park; a graduate student drove to Alaska; my wife worked on a farm in northern Norway; and I climbed in the Wind River Range of Wyoming. In "Ecological Life-styles," a course given at the University of Illinois, undergraduates expressed a strong aversion to an acquisitive life; yet a great majority wanted to travel at least as far as Europe. And they spoke of this as a continuing desire.

Mobility is encouraged by many segments of our society. The automobile and airline industries are obvious proponents, but even hiking and camping clubs contribute. The promotion of the wilderness experience—by stressing the difference between where we live for fifty weeks of the year and where we vacation for two weeks—encourages travel.

Recently we have become sensitized to those aspects of our lives that are particularly energy demanding, and it is no surprise that mobility, or transportation, is high on the list. To quantify the energy input of vacation travel from the standpoint of an individual family, I looked at the energy required to support the average American family's activities. This amounts to about 700 million Btu. annually, the equivalent of 27 tons of coal or 4,700 gallons (110 barrels) of oil. Of this, automobile fuel requires some 100 million Btu., assuming one car driven 10,000 miles per year at 13.6 miles per gallon—the current national average. An additional 75 million Btu. go to manufacture, maintenance, and other automobile-support activities, and to a 20 percent energy penalty on gasoline—the cost of energy spent in extracting, refining, and transporting gasoline. The car's total impact is 175 million Btu., one-fourth of the family's energy budget.

Public transportation—for commuting to work or for vacation—contributes an additional average of 10 million Btu. per family. This much energy would be required to carry a family of four on a plane trip totaling 500 miles, provided all seats on the plane were filled. But for those with wanderlust and money, the public transportation contribution can easily be much larger. My wife's round trip to Norway, for example, which involved 7,000 miles of flying and 2,000 miles of ferry, rail, and bus travel, used about 35 million Btu.

In limiting this discussion to vacation travel, I must make an admission: it is not the major energy user. Vacation use of the automobile, for example, accounts for only 3 percent of total mileage, as opposed to 34 percent for commuting to work. I am, however, concerned here with what we aspire to, as well as with what we do now. With increased affluence the trend will be toward more vacation travel.

I'll use the scheme of comparing two hypothetical families: one backpacks, while the other trailer camps and motorboats. These choices aren't arbitrary; I was interested in seeing if the self-righteousness of some hiker friends about their low-impact vacations was justified.

Our hypothetical families live in Champaign, Illinois. Each has four members, a modest home, a single vehicle, and an average collection of energy-using appliances. The Jack Muirs own an average automobile and vacation on foot in the wilderness. The Manny Watts family bolts its trailer camper to its pickup truck, ties the motorboat on top, then heads for an improved lakeside campground.

I compared the energy impacts of these two families for three possible vacations: one within a few hundred miles, in southern Illinois-Kentucky; one in Glacier National Park; and one in Alaska. In obtaining my figures, I assumed that the Wattses have about $3,500 worth of equipment (camper, boat, and accessories); the Muirs, about $1,000 worth of hiking and camping gear. I further assumed that all the gear would depreciate 7 percent during these vacations, with the exception of the Wattses' recreational vehicle, which would depreciate 15 percent on the trip to Alaska. The Muirs' car gets 13.6 miles per gallon of gasoline; the Wattses' pickup gets 9 miles per gallon. I also made estimates for the Wattses' moderate use of their motorboat and recreational vehicle while the Muirs were in the backcountry.

For trips involving equal en route traveling, the Wattses' energy impact is greater. If, for example, both families travel 250 miles to southern Illinois—the Muirs in their average car, the Wattses in their pickup camper—the Muirs would consume 13 million Btu. on their vacation, while the Wattses would use 39 million. The Muirs could save 3 million Btu. by traveling in a subcompact car, but if the Wattses were to travel in a large, self-contained recreational vehicle, they would increase their energy consumption by 20 million Btu., thus using 59 million.

If both families were to vacation in Glacier National Park, 1,700

PHOTO TRENDS

Comparison of Energy Impacts of Backpackers and Pickup-Trailer Campers for Three Vacations

Distance round trip from Champaign, Illinois	Southern Illinois 500 miles		Glacier National Park 3,400 miles (in millions of Btu.)		Alaska 8,000 miles	
	Total Energy	En Route Energy	Total Energy	En Route Energy	Total Energy	En Route Energy
Manny Watts family						
Pickup camper	39	18	116	101	294	253
Self-contained recreational vehicle	59	18	148	101	362	253
Jack Muir family						
Car—average	13	8	67	60	147	134
Car—subcompact	10	5	39	32	89	76
Bus	—	—	26	19	—	—
Train—Pullman	—	—	89	82	—	—
Airplane	—	—	63	55	131	122

miles from Champaign, the Muirs in their average car would consume 67 million Btu., while the Wattses in their pickup camper would use 116 million Btu. A trip to Alaska, which is 4,000 miles each way, would cost the Muirs 147 million Btu.; the Wattses, 294 million Btu.

The Wattses' greater energy impact is due partly to poorer gas mileage and partly to greater investment in goods. But this "goods" energy is a relatively small fraction for longer trips. For the trip to Glacier National Park, for example, transportation-related energy use is at least two-thirds, and usually more than four-fifths, of the total. (Transportation-related energy costs include, in addition to fuel energy, manufacture of equipment, maintenance and construction of roads or rights-of-way, repairs, parts, parking, and various support activities.) Despite the greater energy impact of their vehicle, if the Wattses go only to Kentucky Lake (a TVA reservoir in western Kentucky), they will use about 40 percent less energy than the Muirs will use in driving to Glacier to backpack.

Another way to visualize the energy trade-off is this: if the Muirs wanted to travel just far enough so that their backpacking vacation energy impact equaled that of the Wattses' trip to Kentucky Lake, they could drive about 950 miles each way. This would get them only 50 miles east of Denver.

For longer trips, however, the Muirs do have the option of using more efficient modes of travel (not so for the Wattses, who must bring their camper). If, for example, the Muirs drove a subcompact car instead of an average-sized vehicle, they could cut their transportation energy by 40 percent. Or they could go by train (coach) or bus, with a savings of 60 percent. While airplane travel would effect very small energy savings, traveling by Pullman would definitely increase the energy impact over that of driving the average car. The surprising result that airplane travel is competitive with that of a car is a consequence of several factors: my assumption of a fully loaded airplane; use of fuel figures from a rather large and, therefore, more efficient plane, the Boeing 707; and the shorter distance covered by flying rather than driving.

The energies we are discussing here range from 5 to 15 percent of the average family's total energy budget. If we now consider an Alaskan trip, the total approaches 40 percent of the average (although a family traveling to Alaska would not be average). Because of the poor gas mileage of the Wattses' car, their Alaskan vacation is more energy intensive than any option the Muirs might take, even an airplane (assuming they don't have supplies air dropped). If the Muirs used a subcompact car (a definite sacrifice of comfort on the Alaska Highway), they would use only a third as much energy as the Wattses.

The general conclusion is that a large stock of capital goods bought for vacation use, assumed to last a reasonable time, has an energy equivalent of rather few miles of transportation. If the Muirs go to Alaska, even in a small car, their low-impact backpacking vacation will still require the extraction of more than twice as much energy from the earth as that of the less athletic Wattses, who sit closer to home in their recreational vehicle. In some cases the Muirs can reduce their energy impact by traveling by bus or train, with some loss of convenience, but a large energy impact remains. If every American took a train to Glacier National Park this summer, it would require energy equaling about 1.9 percent of today's United States total. If instead, they went in groups of four in average cars, the amount would be 4.8 percent; if they did so for nineteen years, they could deplete the reported oil from Alaska's North Slope deposits.

Long trips, even by energy-efficient modes of travel, inevitably use much energy. One might ask if there are ways to reduce the energy impact of other activities, for example, in the home, to offset the energy cost of a vacation. In general, improved home heating and insulation and more efficient transportation to and from work offer great potentials for personal energy savings.

But behind all of this, I still wonder about the basic philosophy of the travel ethic. How fulfilling are short spurts of travel compared to staying home and living through the seasons? Is being free of the travel urge perhaps a question of being fortunate enough to "come down where we ought to be," and does this refer to psychological place as well as, or instead of, physical location? Is travel a universal good or will there always be a conflict between the benefits it gives and the environmental disruption and resource depletion it causes? Documentation of the energy impact of vacation travel can reveal some of the costs, but the benefits must be measured in other ways. ☐

Vistafjord ✦ Sagafjord Cruises. Most people take two.

More than 50% of the passengers who cruise on our two beautiful ships have sailed with us before. And they just couldn't wait to get back to the welcome that's unique to Norway's most experienced world cruise line.

You find it in the service, the cuisine, and in the ships themselves, from your gracious cabin to our dramatic picture-window lounges. You find it in the ports of call, carefully chosen to bring out the best in cruising. And in the warm welcome-back you get when you return from a day ashore.

Where will you cruise with us this year, again or for the first time? It could be the Caribbean or the Mediterranean in spring. Or the glittering North Cape. Eastern Europe, or the South Pacific. Or, in early '75, the Orient or Africa...

So ask your travel agent soon where the Vistafjord and Sagafjord are going. Or call us for brochures. We'd like to welcome you aboard on one of our cruises or two.

CRUISE HIGHLIGHTS 1974-75

From New York (Port Everglades*)

SPRING MEDITERRANEAN, GREEK ISLANDS, April 6*/10. 40 days. 20 ports. Vistafjord.

EASTER WEST INDIES, April 12. 14 days. 7 ports. Sagafjord.

SPRING CRUISE TO EUROPE & BRITISH ISLES, April 26. 35 days. 19 ports. Sagafjord.

NORTH CAPE & FJORDLANDS, June 1. 32 days. 12 ports. Sagafjord.

TWO CARIBBEAN CRUISES, from Port Everglades only, June 3, June 13. 10 days. 4 ports. Vistafjord.

NORTH CAPE & NORTHERN EUROPE, June 23*/25. 42 days. 19 ports. Vistafjord.

SCANDINAVIA AND EASTERN EUROPE, Aug. 7. 30 days. 8 ports. Vistafjord.

FALL MEDITERRANEAN, Sept. 7/9*. 39 days. 15 ports. Vistafjord

SEVEN CARIBBEAN CRUISES, from Port Everglades, Oct. 19-Jan. 4*. 10-17 days. 5-10 ports. Vistafjord.

SOUTH SEAS-EAST INDIES-ORIENT, Jan. 7/10*. 90 days. 23 ports. Vistafjord.

FOUR CONTINENTS, Jan. 21/23*. 79 days. 29 ports. Vistafjord.

✦ *Vistafjord & Sagafjord, the welcome-back ships.*

Norwegian America Line

29 BROADWAY, NEW YORK, N. Y. 10006
Tel. (212) 944-6900.

The Vistafjord and Sagafjord are registered in Norway

Want a good looking, thoughtful, lively, and under-ten-dollar year-round gift?

You're holding it in your hand right now.

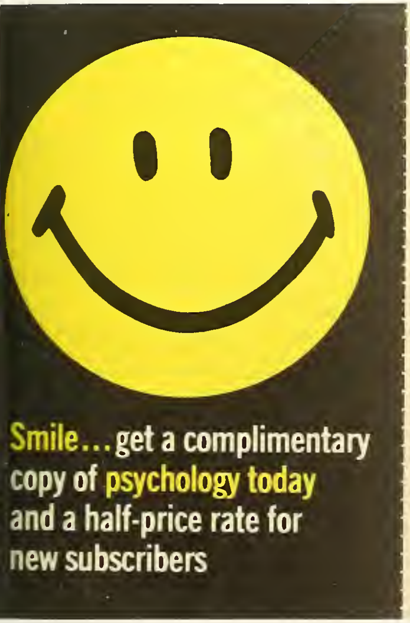
Part of it, that is. For your gift of a one-year subscription to Natural History includes Associate Membership in The American Museum of Natural History (where admission is free to members) ...as well as two specially selected bonus books a year.

What's more, the price of this many-sided, whole-family gift is well under ten dollars. It's all yours for only $8!

So next time you want to remember a birthday, an anniversary, a graduation or any other special occasion, let Natural History make your good wishes both lavish and long-lasting.

NATURAL HISTORY
published by
The American Museum of Natural History
New York, N.Y.

*If someone's already made off with the card, just write
NATURAL HISTORY, P.O. Box 5000, Des Moines, Iowa 50306
Give us your name and address, tell us where the gifts
should be sent (including zip codes, please)
and how you want your gift cards signed.
Send your check with the order ($8 for each gift)...
or if you prefer, just instruct us to bill you later.


Smile...get a complimentary
copy of psychology today
and a half-price rate for
new subscribers

I want a complimentary copy of
Psychology Today

Please send me, without cost, obligation or commitment, my complimentary copy of the current issue. If I like it, bill me for a year's subscription (11 additional issues for a total of 12 in all) at just $6 instead of $12, half the regular price. If I don't like it I will write "cancel" across your bill, return it, and that will be the end of the matter. In either case, the complimentary issue is mine to keep.

Name____________________
PLEASE PRINT

Address____________________

City____________________

State__________ Zip________

Subscriptions outside the U. S. and Canada $2.00 higher.

8227

FIRST CLASS
Permit No. 740
Boulder, Colo.

BUSINESS REPLY MAIL
No Postage Stamp Necessary if Mailed in the United States

Postage will be paid by

psychology today
P.O. Box 2990
Boulder, Colorado 80302

This is Psychology Today

- Why Black Males Lead in Mixed Groups
- Games Babies Play
- How Groupthink Led to Vietnam
- Success and the Mobicentric Executive
- The Importance of Daydreaming
- The Psychology of Police Confessions
- Characteristics of the Successful Investor
- Understanding Children's Art
- Can Fingers See Color?
- Criminals Can Be Brainwashed—Now
- Fantasies at Breastfeeding Time
- Teaching Chimpanzees to Read and Write
- Religious Hang-Ups
- The Screaming Cure—Does It Work?
- How to Quit Smoking
- The Masks We Wear

**Find out what you're missing
Mail card for complimentary copy.**

If card is missing, write Psychology Today,
Box 2990, Boulder, Coloredo 80302

The Nonscience of Human Nature

"We have been deluged during the past decade by a resurgent biological determinism, ranging from 'pop ethology' to outright racism"

When in the seventeenth century a group of girls simultaneously suffered seizures in the presence of an accused witch, the justices of Salem explained the girls' behavior as demonic possession. In 1971, when the followers of Charles Manson attributed occult powers to their leader, no judge took them seriously. During the nearly 300 years separating the two incidents, we have learned quite a bit about the psychological determinants of group behavior. A crudely literal interpretation of such events now seems ridiculous.

An equally crude literalism has prevailed in the past in interpreting human nature and the differences among human groups. Human behavior was simply attributed to innate biology. We do what we do because we are made that way. The first lesson of an eighteenth-century primer stated the position succinctly: In Adam's fall, we sinned all. A progressive advance from this biological determinism has been a major trend in twentieth-century science and culture. We have come to see ourselves as a learning animal; we have come to believe that the influences of class and culture far outweigh the weaker predispositions of our genetic constitution.

Nonetheless, we have been deluged during the past decade by a resurgent biological determinism, ranging from "pop ethology" to outright racism.

With Konrad Lorenz as godfather, Robert Ardrey as dramatist, and Desmond Morris as raconteur, we are presented with the behavior of man, "the naked ape," descended from an African carnivore, innately aggressive and inherently territorial.

Lionel Tiger and Robin Fox try to find a biological basis for outmoded Western ideals of aggressive, outreaching men and docile, restricted women. In discussing cross-cultural differences between men and women, they propose a hormonal chemistry inherited from the requirements of our supposed primal roles as group hunters and child rearers.

Carleton Coon offered a prelude of events to come with his claim (*The Origin of Races*, 1962) that five major human races evolved independently from *Homo erectus* ("Java" and "Peking" man) to *Homo sapiens*, with black people making the transition last. More recently, the I.Q. test has been (mis)used to infer genetic differences in intelligence among races (Arthur Jensen and William Shockley) and classes (Richard Herrnstein)—always, I must note, to the benefit of the particular group to which the author happens to belong.

All these views have been ably criticized on an individual basis; yet they have rarely been treated together as expressions of a common philosophy—a crude biological determinism. One can, of course, accept a specific claim and reject the others. A belief in the innate nature of human violence does not brand anyone a racist. Yet all these claims have a common underpinning in postulating a direct genetic basis for our most fundamental traits. If we are programmed to be what we are, then these traits are ineluctable. We may, at best, channel them, but we cannot change them, either by will, education, or culture.

In various guises, the political function of biological determinism has been to serve the supporters of class, sex, and race distinctions at home and of conquest or domination of supposedly inferior peoples abroad. In the context of Western history, this means that biological determinism has served as a tool of state and commercial power.

If we accept the usual platitudes about "scientific method" at face value, then the coordinated resurgence of biological determinism must be attributed to new information that refutes the earlier findings of twentieth-century science. Science, we are told, progresses by accumulating new information and using it to improve or replace old theories, but the new biological determinism rests upon no recent fund of information and can cite in its behalf not a single fact. Its renewed support must have some other basis, most likely social or political in nature.

Science is always influenced by society, but it operates under a strong constraint of fact as well. The Church eventually made its peace with Galilean cosmology. In studying the genetic components of such complex human traits as intelligence and aggressiveness, however, we are freed from the constraint of fact, for we are sure of practically nothing about these traits. In these questions, "science" follows (and indirectly exposes) the social and political influences of the time.

What, then, are the nonscientific reasons for the resurgence of biological determinism? They range, I believe, from pedestrian pursuits of high royalties for best sellers to pernicious attempts to reintroduce racism as respectable science. Their common denominator must lie in our current malaise. How satisfying it is to fob off the responsibility for war and violence upon our presumably carnivorous ancestors. How convenient to blame the poor and the hungry for their own condition—lest we be forced to blame industry or government for our abject failure to secure a decent life for all people. And how convenient an argument it is for those who control government and, by the way, provide the money that current science requires for its very existence!

The deterministic arguments divide neatly into two groups—those based on the supposed nature of the human species in general and those based on presumed differences among "racial groups" of *Homo sa-*

piens (see my column of March, 1974). I shall treat the first subject here and reserve the second for my next column.

Summarized briefly, mainstream pop ethology contends that two lineages of hominids inhabited Pleistocene Africa. One, a small, territorial carnivore, evolved into us; the other, a larger, presumably gentle herbivore, became extinct. Some carry the analogy of Cain and Abel to its full conclusion and accuse our ancestors of fratricide. The "predatory transition" to hunting established a pattern of innate violence and engendered our territorial urges: "With the coming of the hunting life to the emerging hominid came the dedication to territory" (Ardrey, *The Territorial Imperative*).

According to this view, although clothed, citified, and civilized, we carry deep within us the genetic patterns of behavior that served our ancestor, the "killer ape." In *African Genesis* Ardrey champions Raymond Dart's contention that "the predatory transition and the weapons fixation explained man's bloody history, his eternal agression, his irrational, self-destroying, inexorable pursuit of death for death's sake."

Tiger and Fox extend the theme of group hunting to claim a biological basis for the differences between men and women that Western cultures have traditionally valued. Men did the hunting; women stayed home with the kids. Men are aggressive and combative, but they also form strong bonds among themselves that reflect the ancient need for cooperation in the killing of big game and now find expression in touch football and rotary clubs. Women are docile and devoted to their own children. They do not form intense bonds among themselves because their ancestors needed none to tend their homes and their men: sisterhood is an illusion. "We are wired for hunting. . . . We remain Upper Paleolithic hunters, fine-honed machines designed for the efficient pursuit of game" (Tiger and Fox, *The Imperial Animal*).

The pop ethology story has been built on two lines of supposed evidence, both highly disputable:

1. Analogies with the behavior of other animals (abundant but imperfect data). No one doubts that

Now . . . let your *eyes*
do the measuring!

OPTICAL
TAPEMEASURE

Feet
OPTICAL TAPEMEASURE

NOW MEASURE DISTANCE WITHOUT MOVING AN INCH . . .

Do it right from where you're standing . . . without help from another person . . . without climbing or awkward maneuvering . . . without worrying about ladders, obstacles, building materials, mud or snow . . . and without ribbons, tapes, chalk, strings or cords. If you can *see* the target, you can *measure* it! With the new Optical Tapemeasure your *eyes* do the work.

There's never before been an instrument like this—anywhere! The Optical Tapemeasure gives you precision measurements of any distance from 6 to 100 feet—in seconds. Measures *height,* too. You simply sight the object—fencepost, roof peak, electrical outlet, room corner—through the viewfinder. You'll see two images of it. Turn the focusing dial until both images "merge" into one. Then glance at the tape indicator to read the distance in feet and/or inches. That's all there is to it. It's fast . . . dependable . . . accurate (99.2% accurate at 25 feet, 97.8% at 100 feet). Ideal for contractors . . . painting, roofing, siding and wiring estimators . . . surveyors, road builders, real estate agents, home construction firms, architects, insurance firms, accident investigators . . . and a great gift for home handymen, gardeners, etc.

Pocket-size, the Optical Tapemeasure is 5½" x 3¼" x 1" and weighs just 8 ounces. Carry it anywhere. Rugged, light green Cycolac® body with welded steel inner construction, shock absorbing optical mounts, dustproof interior. Warranteed for *5 years* against defective parts and workmanship by the famous American optics manufacturer. Also includes deluxe zippered carry case in handsome brown doeskin vinyl. Gift-boxed, of course.

Order today. Send check or money order, or charge your Credit Card. **Give Account No., Bank No. (if any), Expiration Date and Signature.** N.Y. residents add tax.

Order No. 41450: Optical Tapemeasure, $19.95 plus $1.50 shipping and handling.

THE *EVERYTHING* GUARANTEE
The Gallery guarantees *EVERYTHING:* the quality, accuracy of description, availability, prompt delivery. If not delighted, return Optical Tapemeasure within 3 weeks after you receive it (not the usual 10 days) for an instant refund or cancellation of charges.

Free Gift Catalog On Request

THE FINER THINGS BY MAIL **GALLERY**
Dept. 1375, Amsterdam, N.Y. 12010

MAIL THIS COUPON TODAY
THE GALLERY, Dept. 1375, Amsterdam, N.Y. 12010
Rush me (quantity)__________ **Optical Tapemeasure(s) (Order No. 41450)**
at **$19.95** plus $1.50 shipping and handling each.
☐ Check or money order enclosed:__________ (N.Y. State residents, add sales tax.
Charge my ☐ American Express ☐ BankAmericard ☐ Master Charge ☐ Carte Blanche
Account No.__________ Bank No. (if any)__________
Expiration Date__________ Signature__________
Print Name__________
Address__________
City__________ State__________ Zip__________

You can help save Aurora Cortez for $15 a month. Or you can turn the page.

Here are some facts about Aurora Cortez, her family, and her town—Plato, Magdalena, on the coast of Colombia. No editorializing. No embellishment. Just facts.

Aurora is five years old. She lives with her parents and three brothers and sisters in a house made of mud and bamboo.

No electricity. No running water. No sanitary facilities. Aurora's father earns $1.00 a day herding cattle. And there is about a 50% chance that Aurora will grow up illiterate. Because it costs money to go to school in Colombia. Money her father doesn't have.

But for $15 a month through Save the Children Federation you can sponsor a Colombian child like Aurora. Send her to school. Improve her living conditions. Help her neighbors rebuild the bridge that connects Plato to the town's only hospital.

Help people—indeed, help an entire community—to help itself.

For you there are many rewards. The chance to correspond with a child. To receive a photograph. And progress reports. And above all, to know you are reaching out to another human being. That's how Save the Children works. But without you it can't work. So please: clip this coupon and mail it today. Now you can turn the page.

Save the Children Federation, founded in 1932, is registered with the U.S. State Department Advisory Committee on Voluntary Foreign Aid. Contributions are income tax deductible.

I wish to contribute $15 a month to sponsor a ☐ boy ☐ girl:

☐ **Where the need is most urgent**

☐ Africa
☐ Appalachia (U.S.)
☐ Bangladesh
☐ Chicano (U.S.)
☐ Europe
☐ Indian (U.S.)
☐ Inner Cities (U.S.)
☐ Israel
☐ Korea
☐ Latin America
☐ Middle East
☐ Southern Black (U.S.)
☐ Vietnam

Enclosed is my first payment:

☐ $180 annually
☐ $90 semi-annually
☐ $45 quarterly
☐ $15 monthly

☐ Instead, enclosed is my contribution of $________
☐ Please send me more information.

NAME________________ TEL. NO.________

ADDRESS____________________

CITY________ STATE________ ZIP________

David L. Guyer, Executive Director

SAVE THE CHILDREN FEDERATION

345 East 46th Street, New York, N.Y. 10017

NH 4/4

Sankyo cures the fuzzies

It looked great in the viewfinder. But when you projected it on the screen: fuzzy. It happens a lot, and we know why. Focusing problems. It's *hard* to focus quickly on a moving subject. We've got the cure. A unique superimposed image rangefinder focusing system. It works quickly, simply, surely, every time. It's in every Sankyo Hi-Focus Movie Camera. It's not in any other camera. Just one of many advanced Sankyo features. Just one reason why tomorrow's movies will be made with Sankyo. Inspect Sankyo home movie equipment at your camera dealer or write for free literature.

Tomorrow's movies will be made with Sankyo.

Sankyo Seiki (America) Inc.
149 Fifth Avenue, New York, N.Y. 10010 / 212-260-0200
West Coast Branch:
13000 S. Athens Way, Los Angeles, Calif. 90061 / 213-321-0320

many animals (including some, but not all, primates) display innate patterns of aggression and territorial behavior. Since we exhibit similar behavior, can we not infer a similar cause? The fallacy of this assumption involves a basic difference in evolutionary theory between homologous and analogous features. Homologous aspects of two species are due to a common descent and a common genetic constitution. Analogous traits evolved separately.

Comparisons between human beings and other animals can yield causal assertions about the genetics of our behavior only if they are based on homologous traits. But how can we know whether similarities are homologous or analogous? It is hard to differentiate even when we are dealing with concrete structures, such as muscles and bones. In fact, most classic arguments in the study of phylogeny involve the confusion of homology and analogy, for analogous structures can be strikingly similar (we call this phenomenon evolutionary convergence). How much harder it is to tell when the similar features are only the outward motions of behavior!

Baboons may be territorial; their males may be organized into a dominance hierarchy—but is our quest for Lebensraum and the hierarchy of our armies an expression of the same genetic makeup or merely an analogous pattern that might be purely cultural in origin? And when Lorenz compares us with geese and fish, we stray even further into pure conjecture; baboons, at least, are second cousins.

2. Evidence from hominid fossils (scrappy but direct data). Ardrey's claims for territoriality involve the assumption that our African ancestor *Australopithecus africanus*, was a carnivore. The evidence is based on accumulations of bones and tools at the South African cave sites and on the size and shape of teeth. The bone piles are no longer seriously considered; they are more likely the work of hyenas or leopards than of hominids.

Teeth are granted more prominence, but I believe that the evidence is equally poor if not absolutely contradictory. The relative size of grinding teeth (premolars and molars) is the basis of the argument. Herbivores need more surface area to grind their gritty and abundant food. *A. robustus*, the supposed gentle herbivore, possessed grinding teeth relatively larger than those of the presumed carnivore, our ancestor *A. africanus*.

But *A. robustus* was the larger of the two species. As size increases, an animal must feed a body growing as a cube of length by chewing with tooth areas that would increase only as the square of length if they maintained the same relative size. This will not do, and larger mammals must have differentially larger teeth than smaller relatives. I have tested this assertion by measuring tooth areas and body sizes for species in several groups of mammals (rodents, piglike herbivores, deer, and several groups of primates). Invariably, I find that larger animals have relatively larger teeth—not because they eat different foods, but simply because they are larger.

Moreover, the "small" teeth of *A. africanus* are not at all diminutive. They are *absolutely larger* than ours (although we are three times as heavy), and they are about as big as those of gorillas weighing nearly ten times as much! The evidence of tooth size indicates to me that *A. africanus* was primarily herbivorous.

The issue of biological determinism is not an abstract matter to be debated within academic cloisters. These ideas have important consequences, and they have already permeated our mass media. Ardrey's dubious theory is a prominent theme in Stanley Kubrick's film *2001*. The bone tool of our apelike ancestor first smashes a tapir's skull and then twirls about to transform into a space station of our next evolutionary stage. Kubrick's next film, *Clockwork Orange*, continues the theme and explores the liberal dilemma inspired by claims of innate human violence. (Shall we accept totalitarian controls for mass deprogramming or remain nasty and vicious within a democracy?) But the most immediate impact will be felt as male privilege girds its loins to battle a growing women's movement. As Kate Millett remarks in *Sexual Politics*: "Patriarchy has a tenacious or powerful hold through its successful habit of passing itself off as nature.

Columnist Stephen Jay Gould teaches geology at Harvard University.

In 1950 Dr. Immanuel Velikovsky was pronounced a heretic and his unorthodox theories were banned from discussion at scientific gatherings.

In June, 1974, leading scholars and scientists from around the world will gather in Ontario on the theme, "Velikovsky and the Recent History of the Solar System."

Many things have happened during the last 24 years. *Pensee* is one of them.

A REPORT ON THE VELIKOVSKY AFFAIR

In the Spring of 1972 the Student Academic Freedom Forum (*Pensee* magazine) initiated a special series of publications examining the work of Immanuel Velikovsky. In his bestseller, *Worlds in Collision,* Velikovsky questioned the fundamental assumptions of disciplines ranging from psychology to physics to ancient history, and he claimed that Earth suffered near-annihilating catastrophes several times during recorded history. That thesis, once scoffed at, has gained more respect with each passing year. The one-time heretic is now in strong demand at scholarly gatherings around the United States and elsewhere. Here is a summary of some of the more important events since the appearance of our first special publication in 1972:

NASA AMES RESEARCH CENTER. *August 14, 1972.* Following Velikovsky's invited lecture and consultations with Ames personnel, Dr. Richard Haines, a research scientist at the center, wrote in *Pensee:* "I believe that the time has come to leave the debating table and begin the enormous task of evaluating empirically those hypotheses of Dr. Velikovsky's that are amenable to scientific study."

"VELIKOVSKY SYMPOSIUM," LEWIS AND CLARK COLLEGE. *August 16-18, 1972.* For three successive days 50 "invited scholars" and 200 "observers" crowded into the Council Chambers at Lewis and Clark College (Portland). Coming from as far away as Europe, they comprised the first large-scale symposium on Velikovsky's work. The papers were subsequently published in *Pensee.*

MEDIA DOCUMENTARIES. *1972–.* Both the Canadian and British Broadcasting Corporations have produced major-length television documentaries on Velikovsky's work. Titled "Velikovsky: The Bonds of the Past" (CBC) and "Worlds in Collision" (BBC), the documentaries were each shown at least twice. A Dutch television network recently aired a whole series of programs on Velikovsky, and Voice of America is preparing a presentation of its own.

NASA LANGLEY RESEARCH CENTER. *December 10, 1973.* Responding to an enthusiastic invitation to lecture at Langley, Velikovsky predicted that Mars will be found to show the effects of near-collisions with Earth.

"VELIKOVSKY'S CHALLENGE TO SCIENCE," A SYMPOSIUM SPONSORED BY THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. *February 25, 1974.* The largest scientific body in the country held the symposium at its annual convention in San Francisco. The speakers: Immanuel Velikovsky; Peter Huber (professor of the history of science, Eidgenössische Technische Hochschule, Switzerland); Irving Michelson (professor of mechanics and mechanical aerospace engineering, Illinois Institute of Technology); J. Derral Mulholland (professor of astronomy, University of Texas); Carl Sagan (professor of astronomy, Cornell University); Norman Storer (professor of sociology, Baruch College, City University of New York).

"VELIKOVSKY AND THE RECENT HISTORY OF THE SOLAR SYSTEM," A SYMPOSIUM. *June 17-19, 1974.* Sponsored by the Student Academic Freedom Forum, this symposium will be held at McMaster University, near Toronto. Among the participants:

Immanuel Velikovsky;
Sergei Vsekhsvyatskii, director, Kiev Observatory, U.S.S.R.;
Claude Schaeffer, Chaire d'Archéologie de l'Asie Occidentale, Collège de France;
Irving Michelson, professor of mechanics and aerospace engineering, Illinois Institute of Technology.

"VELIKOVSKY AND THE POLITICS OF SCIENCE," A SYMPOSIUM. *November 2, 1974.* Scheduled as part of the Philosophy of Science Association biennial convention, Notre Dame University, Indiana.

Pensee has already published 6 issues of a 10-issue series, "Immanuel Velikovsky Reconsidered." Order your introductory issue now for only $3.

Pensee Magazine
P.O. Box 414 nh
Portland, Oregon 97207

Gentlemen: Please send me __ copies of issue #1 ($3 each) in the Immanuel Velikovsky Reconsidered series. I enclose full payment.

Name ____________________
Address ____________________
City __________ State _____ Zip _______

A New Profile for the Wolf

With sufficient prey and enlightened human neighbors, this endangered predator could multiply and reclaim its former range

by L. David Mech

One of the most fortunate and gratifying characteristics of science is that it is self-correcting. If one scientist commits an error, sooner or later another, or maybe the same one, will discover it and make the necessary correction. In fact, the scientific body of knowledge is subject to continual change, and old ideas are being modified every day.

Research on wolves is an excellent case in point. It wasn't until the 1940s that science, in the persón of Adolph Murie, began thoroughly revising the body of wolf "knowledge" that men had been accumulating for centuries without the benefit of the scientific method. During the decade following Murie, a few more biological studies of the wolf were conducted. In the 1960s a virtual blossoming of serious investigations into wolf behavior and ecology brought forth much new information, forging a rough approximation of the truth about the wolf.

The process continues today, and the forging is becoming finer. It is time to stand back and take another look at the results.

ROD ALLIN, BRUCE COLEMAN, INC.

MARTY STOUFFER, BRUCE COLEMAN, INC

BRUCE COLEMAN, INC.

Timber wolves communicate their location and identity by howling, a sound rarely heard outside of Minnesota, Alaska, and Canada.

Consider the question of wolf habitat. Wolves have long been thought to prefer vast expanses of wilderness; northern coniferous forests or windswept tundra are widely regarded as typical wolf habitat. Habitat destruction is commonly believed to be one of the main reasons wolves have been exterminated from 99 percent of their former range in the United States outside of Alaska. But let us look more closely.

Originally wolves were distributed throughout virtually all of the major habitat types north of 20° north latitutde, which runs through Mexico and India. They preyed on the major large herbivorous mammals in these areas: deer, moose, caribou, elk, antelope, mountain sheep and goats, bison, musk oxen, and beavers. Even after man drastically changed the habitat through logging, fires, and agriculture, wiping out these prey species from vast areas, wolves remained and preyed upon their substitutes: horses, cattle, sheep, goats, pigs, and reindeer. The presence of suitable prey and the absence of persecution is more important to the wolf than habitat.

Most people in North America think wolves prefer wilderness because that is primarily where most of the wolves remain today. But this is only because wilderness areas are the only places where wolves have not been persecuted. In several European countries where much of the populace resides in small rural villages and no longer persecutes wolves so intensively, wolves live in proximity to people. They may wander through a village at night and snatch up the local dogs or even visit the outskirts of a large city such as Rome. In North America they are quickly shot or trapped if they do this.

During whelping time in April, wolves in Minnesota produce an average litter of five or six pups at their den sites.

This brings up another facet of wolf ecology that needs clarification. We have learned during the past decade or so that wolf populations seem to be self-regulating. It is said that wolves "are limited by their own social controls, so if they are left alone by man, they will control themselves." I believe this is true as it pertains to most wilderness areas.

However, on the edge of the wilderness—for example, the interface between wilderness and farmland in central Minnesota—part of the social control takes the form of lone wolves dispersing into farming country. This expansion of range brings about a population increase, although the wilderness population from which the dispersers originated does seem to be self-regulating and therefore stable. In the peripheral wolf range of Minnesota, this population increase has always been a temporary one because wolves colonizing farm areas are persecuted by local residents and killed by predator-control programs.

The question of population stability also arises in discussing wolf prey. It has been claimed that in some areas wolves keep their prey populations stable. One of the most intensive wolf-prey studies ever conducted—on Isle Royale in Lake Superior—seemed to indicate just that, and I was one of the researchers who drew that conclusion. During my three years (1958–61) of studying the wolves and moose on that 210-square-mile island, my counts of wolves, moose, moose reproduction, and wolf kills seemed to add up to a relatively stable population of both wolves and moose. My moose estimate was 600 animals.

Other researchers, under the direction of Prof. Durward L. Allen of Purdue University, continued to keep track of the Isle Royale wolves and moose for the next several years. In 1967, Allen and graduate students Peter Jordan and Phil Shelton estimated that there were 800 to 1,000 moose on the island; by 1971 the estimate had risen to 1,000 moose.

In short, the moose estimates made by successive researchers on Isle Royale continued to increase. This posed interpretational problems. Was the first estimate of 600 merely wrong and the later ones correct; or were the later ones wrong and the former correct? Were all the estimates correct, reflecting an actual increase in the moose herd? (We won't consider the fourth possibility—that all the estimates were wrong, and none of us knew what he was doing.)

This was a most important set of questions because if the moose herd had increased during the decade or so of the studies, then my former conclusion that the wolves were regulating the moose herd was wrong. At most, the wolves (whose numbers had remained basically the same throughout this period) might only have been "dampening" the moose increase and not really holding the herd stable.

It took an independent study, by forest ecologists Henry Hansen, Larry Krefting, and Vilis Kurmis, to provide the clues needed to answer these questions. Krefting had worked on Isle Royale for twenty-five years, studying the relationship between moose numbers and available browse. His counts of moose pellet groups, while not allowing an absolute estimate of moose numbers, did provide an index to the relative sizes or trends in sizes of herds. Published in late 1973, these figures were most revealing. The average number of pellet groups he found per acre were as follows: 1961, 63; 1965, 83; 1970, 113. Either the moose were defecating more, or they were increasing.

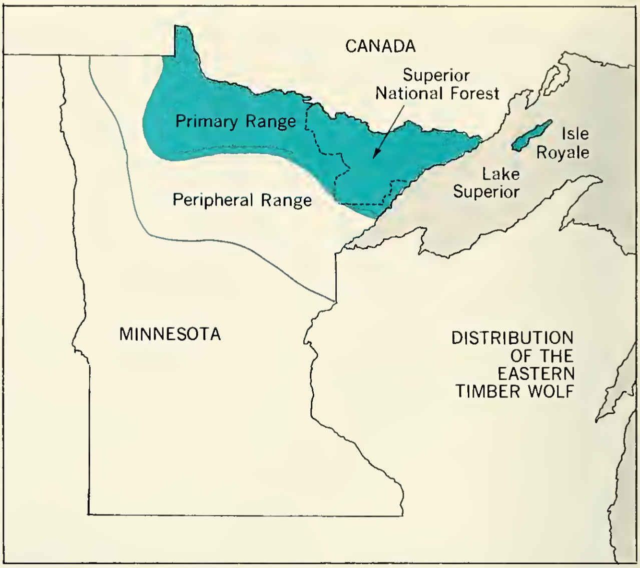
Thus it appears that, at present, the Isle Royale wolves are not regulating the moose herd; they are only cropping off part of the available surplus production each year. Perhaps as moose numbers approach the carrying capacity of the browse supply and individuals weaken, wolf predation will have a greater effect on, and may help reduce, the moose herd. Then we will have to refine our thoughts again.

Another recent conclusion that needs refining pertains to the densities that wolf numbers themselves may reach. On Isle Royale the density averaged out to about one wolf per ten square miles and has remained about that for more than a decade at least. In Algonquin Provincial Park, Ontario, when wolves were legally protected instead of bountied, their numbers increased before leveling off to about one wolf per ten square miles.

These findings, plus those from a few other areas, led wolf authority Douglas H. Pimlott to conclude that an average of one animal per ten square miles was a saturation point for wolves—they could not tolerate higher densities. This conclusion was well accepted and publicized, and I could not help but agree with it. After much intensive research on wolf numbers in the Superior National Forest in northeastern Minnesota, my figures showed a basically stable population from 1966 through 1972 again at a level of about one wolf per ten square miles.

But a few other studies began to turn up some exceptions. Ernie Kuyt and Gerald Parker, Canadian Fish and Wildlife Service biologists, working independently on caribou wintering areas in the Northwest Territories of Canada and in northern Manitoba and Saskatchewan, discovered that wolf densities could compress in winter. Kuyt estimated an average density of one wolf per 6.9 square miles, and Parker, one per 7 to 8 square miles. Furthermore, graduate student Victor Van Ballenberghe, studying the eastern edge of the Superior National Forest along the shore of Lake Superior (east of my own study area) found a 213-square-mile strip of wolf pack territories in which the densities reached an average of one wolf per 5.3 square miles.

All these exceptions involved areas of extreme prey densities. Caribou averaged 68 per square mile in their Canadian wintering areas. Deer densities in the Lake Superior shore area had not been estimated when the wolf counts were made, but some ten years earlier they had been estimated at 166 deer per square mile in one of their winter yards in the area.



Thus while it is still true that average wolf densities do not exceed one wolf per ten square miles (and are usually far lower than this), during certain periods of exceptionally high prey concentrations, wolf densities may almost double.

Determining the densities of wolves in an area is directly related to estimating the population. Recent findings have led to some significant revisions in estimates of wolf numbers. One of the most important wolf populations in the United States inhabits the Superior National Forest. Outside of Alaska, Canada, and Isle Royale, Minnesota is the only area in North America (except perhaps Mexico) that has a significant population of wolves. (Probably fewer than fifty individuals remain in the rest of the country.) Within Minnesota's 24,000 square miles of wolf range, Superior National Forest, including the Boundary Waters Canoe Area, is the largest block of public land (4,200 square miles) with the best chance of not being despoiled by human settlement or industrialization.

Therefore it is important to know how many wolves inhabit Superior Forest. Some of the residents living nearby (many with strong antiwolf feelings) have long felt that there are about 4,000; yet a preservationist group based in California believes there are no more than 200 wolves in all of Minnesota. Milt Stenlund, biologist for the Minnesota Department of Natural Resources, estimated in 1955 that there were roughly 240 wolves in Superior. There have been a number of other official and unofficial guesses and estimates, but except for Stenlund's, there were very scanty data for any of them.

After six years of intensive research, involving the radio tagging of seventy-seven wolves, locating them by radio more than 3,000 times, observing them from the air more than 1,300 times, and supplementing these data with observations of nonradioed wolves and their tracks throughout this period, I have finally arrived at an estimate that I am confident is accurate.

The results indicate that at least from 1966–67 through 1971–72 the wolf population of Superior National Forest remained relatively stable at about 400 wolves during early winter and 300 just before whelping time in April. In 1972–73, a noticeable decline brought the estimate down to about 270 wolves in the spring. This decrease may be closely linked to a general decline in deer numbers that is occurring throughout northeastern Minnesota, as well as in other areas of the mid-northern states and south-central and southeastern Canada. The decline of the wolf's natural prey is apparently caused by maturing forests and an increasing predominance of coniferous trees, a habitat that is incapable of supporting large numbers of deer.

No doubt several other well-researched "facts" about the wolf will someday turn out to be not quite correct, and we will have to revise our thinking again. Each new set of figures, each conclusion, and each prediction put forth by any wolf biologist will come under scrutiny by others. This will result in still further refinements in our knowledge and a repeat of the self-corrective process.

It must be admitted that in this manner we have already come a long way from the days when it was accepted truth that wolves traveled in packs of hundreds of animals, suckled lost children, and were particularly fond of devouring little girls with red hoods. ☐

It had been thought that the predator–prey relationship between the wolves and moose on Isle Royale, Lake Superior, regulated the numbers of moose on the island. The latest data, however, show that wolf kills have only a dampening effect on the moose population, which has increased in recent years from about 600 to 1,000.

L. DAVID MECH

Evolution under Attack

Will America become the laughingstock of the educated world by turning the clock back on Darwin's theory?

by Norman D. Newell

photographs by David Muench

An old controversy concerning the origins of life and biological change is being quietly rekindled. The special creationists, who believe in the literal truth of the biblical account of creation despite the contrary evidence of astronomy, geology, paleontology, and genetics, are once again opposing the evolutionists. The issue is how the history of life should be taught in public school science classes.

Organic evolution was publicly challenged in this country in the Scopes trial of 1925 in Dayton, Tennessee. Although Scopes lost this test case, the fundamentalist position, as expounded by William Jennings Bryan, was made to appear so untenable that it was presumed by the scientific community and the public at large that special creation would never again be an issue in public education. That conclusion was premature.

In 1971, the Board of Education in Columbus, Ohio, passed a resolution encouraging teachers to present special creation along with evolution in discussions of the origin of life or the universe. After nine years of petitioning, the California State Board of Education ruled in 1972 that henceforth science textbooks must teach evolution as a theory rather than a fact, and that all statements on Darwinism must be carefully qualified. This was a compromise. What the fundamentalist lobbyists had sought was equal time in science teaching for the theory of special creation. More recently, the board adopted a resolution to require equal recognition of creationism in social science textbooks wherever evolution is discussed. And efforts are still being made in California to compel publishers to join creation and evolution in biology texts.

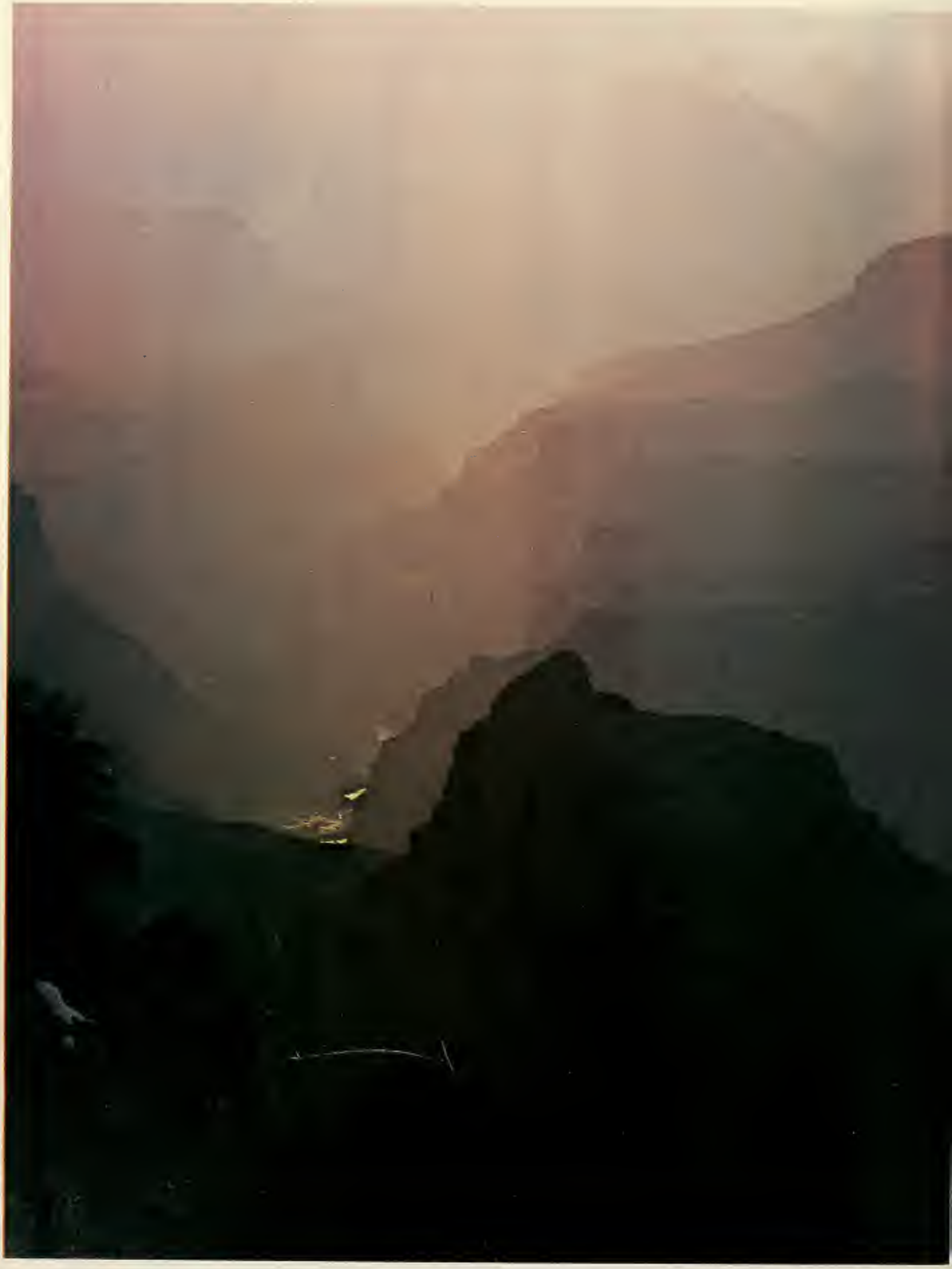
In 1972, William F. Willoughby, religion editor of the *Washington Star-News*, brought suit as a private citizen in U.S. District Court against the National Science Foundation and its Biological Sciences Curriculum Study to force withdrawal of NSF-sponsored biology textbooks on the grounds that they present the Darwinian theory of the origin of man as fact, not theory, and omit mention of special creation. The NSF has estimated that about 45 percent of today's high school students study from BSCS texts, which were introduced in 1960. In 1973 the suit was dismissed. A bill requiring equal time for special creation in science classes is presently pending in the Georgia State Legislature. Similar legislation was passed in Tennessee in 1973 but was defeated in Michigan, Colorado, and Washington.

The National Association of Biology Teachers is deeply concerned that the academic freedom of public school teachers is being threatened and the basic principles of science are being attacked. The association is presently combating the creationists in the Tennessee courts and expects to carry its case as far as the U. S. Supreme Court if necessary. The biologists argue that the new Tennessee statute contravenes the free speech clause of the first amendment and the due process clause of the fourteenth.

Professional biologists in various parts of the United States have protested the lobbying tactics of the creationists, and several of the nation's academic and scientific organizations have passed resolutions condemning the creationists' proposals on the grounds that special creation is theology, not science, and should not be represented to public school children as a reasonable scientific alternative to the theory of organic evolution. Included among these organizations are the American Association for the Advancement of Science, the American Chemical Society, The University of California Academic Senate, and the National Academy of Science. The last-named, the most distinguished scientific body in the United States, was established by Abraham Lincoln to advise the government on scientific matters.

Who are the special creationists? Primarily, they are members of small, independent, predominantly fundamentalist groups. Many belong to evangelical churches whose total United States membership is estimated at about twenty million. Fundamentalists are not a monolithic assemblage; their viewpoints range from conservative to progressive, and they often find no conflict between science and religion. Perhaps the most vocal of the antievolutionist groups is the Creation

The Grand Canyon is about 1 mile deep, 4 to 18 miles wide, and approximately 217 miles long. Its clearly visible rock strata are a record of geologic change. Creationists say the canyon and its rock record were formed in about fourteen months by the waters of the Flood. Evolutionists say the canyon was formed over a period of at least two billion years by the natural process of sedimentation, erosion, the upwelling of molten rock, and slow movements in the earth's crust.



Research Society of San Diego, which has developed its own textbook, *Biology: A Search for Order in Complexity*, and whose members were active in the 1972 California ruling. Founded in 1963, this society, which currently numbers about 300 full members and 1,200 sustaining and student members, has two requirements for voting membership. Applicants must hold an earned advanced degree in a recognized area of science and, like the nonvoting members, who need not possess an M.A., M.S., or Ph.D., they must subscribe to the society's credo, which states in part that

> the account of origins in Genesis is a factual presentation of simple historical truths.
>
> All basic types of living things, including man, were made by direct creative acts of God during Creation Week. . . . Whatever biological changes have occurred since Creation have accomplished only changes within the original created kinds.
>
> the Noachian Deluge was an historical event, worldwide in its extent and effect.

These tenets are a throwback to the frankly scriptural explanation of living forms that prevailed in the first half of the nineteenth century. They echo the then held belief that all life came into being separately and spontaneously, that species are discrete and immutable, that nature is static, and that consequently all forms that would ever exist were already in existence. At the time it was also widely accepted that the universe and man were created in the year 4004 B.C., a date derived by Archbishop James Ussher, a seventeenth-century Irish prelate and scholar, from his study of biblical genealogies.

A very different view of nature is held by the evolutionists. They think in terms of a world of enormous antiquity and gradual, continuous change in which existing plants and animals, including man, have slowly evolved from previously living forms. They also believe the process of evolution is still going on.

Evolutionary thinking began to appear many years before Charles Darwin formulated his theory. Darwin's grandfather, physician-naturalist Erasmus Darwin, wrote in 1794, "Would it be too bold to imagine that in the great length of time since the earth began to exist, perhaps millions of ages before the history of mankind . . . all warm-blooded animals have arisen from one living filament?" And Jean Baptiste Lamarck, French naturalist and professor of zoology, said in the early nineteenth century, "Citizens, go from the simplest to the most complex and you will have the true thread that connects all the productions of nature; you will have an accurate idea of her progression; you will be convinced that the simplest living things have given rise to all others."

What Charles Darwin did in the *Origin of Species* was assemble and interpret the evidence for evolution and discover the principle of natural selection by which it operates. Through a historic coincidence, Alfred Russel Wallace, another English naturalist, had simultaneously and independently deduced the same principle. This is how Darwin described that part of his theory in the introduction to *Origin*, published in 1859:

> As many more individuals of each species are born than can possibly survive [the doctrine of Malthus]; and as, consequently, there is a frequently recurring struggle for existence, it follows that any being, if it vary however slightly in any manner profitable to itself, under the complex and sometimes varying conditions of life, will have a better chance of surviving, and thus be *naturally selected.* From the strong principle of inheritance any selected variety will tend to propagate its new and modified form.

Most biologists now recognize natural selection as the directive force in evolution. No modern evolutionist believes that evolution is the result of a long series of random accidents. Darwin, however, did not know the cause of the variations he had noted within species, nor how they were passed on to succeeding generations. That gap has been closed by the subsequent discovery of the mechanism of inheritance and knowledge of genes, mutations, and the genetic recombination that always results from sexual reproduction.

Since evolution by natural selection was incompatible with the basic beliefs of many religious creeds, especially with the presumed place of mankind in the scheme of things, *Origin of Species* caused an uproar throughout the Western world. It precipitated widespread polarization among the general public in Europe and America, separating those who insisted on the literal interpretation of the book of Genesis as a historical account from those who regarded Genesis as a poetic legend. The controversy was seen as pitting science against religion. It was dramatized in the 1860 debate between Bishop Samuel Wilberforce, upholding Genesis, and Thomas H. Huxley, defending Darwin, during which the bishop asked his opponent whether it was through his grandfather or his grandmother that he claimed descent from an ape.

Although the theories of evolution and special creation are essentially the same today as they were in Darwin's time, the latter-day creationists have not mounted a frontal attack on evolution and, for constitutional reasons, they carefully avoid mention of Genesis in their proposals for the public schools. Instead, they assert that the creation theory is as valid as evolution and therefore deserves equal attention in schoolrooms, and that the dispute this time around pits science against itself. Full members of the Creation Research Society hold, after all, master's and doctoral degrees in science.

Nevertheless, as the time approached for the California Board of Education to make its 1972 decision, nineteen resident Nobel laureates sent a letter of protest in which they said, "No alternative to the evolutionary theory gives an equally satisfactory explanation of the biological facts." At a juncture when science and technology have split the atom, cracked the genetic code, and put men on the moon, the current revival of pre-Darwinian theory has an eerie, dreamlike quality.

The authoritarian and apparently impregnable cosmology of the Christian Middle Ages was overthrown in the sixteenth and seventeenth centuries by Copernicus, Bruno, Kepler, and Galileo, and the descriptive mechanics of celestial bodies was established by Newton. These men did not, however, conceive of a long prior history of gradual change in the universe. Time is crucial to the process of evolution. The long, slow change outlined by the evolutionists required a far greater antiquity for the earth than the orthodox 6,000 years. Based on the minimum amount of time needed to lay down and then denude ancient layers of sediment in southern England, Darwin himself estimated the age of the earth at millions of years. In this century, that figure has undergone a massive upward revision. The universe is now generally believed to be about ten billion years old, and the earth about five billion. Life is believed to have originated on our planet some three or four billion years ago. That is ample time for the drama of organic evolution.

The work of early geologists and the discovery and interpretation of trends in the form and structure of fossils played an important role in the development of evolutionary thinking.

The basic principles of earth history are illustrated by the work of many brilliant scientists, spanning the period from the seventeenth century to the early 1900s. Among them were Nicolaus Steno, James Hutton, William Smith, Charles Lyell, and Darwin. They opened the way for historical interpretations of the origins of earth and its life and the evolution of stars and planets.

Steno's contribution appeared in 1669. He developed his theory of geologic development through his studies of crystal growth and larger features such as layered sedimentary and volcanic rocks. He demonstrated that these phenomena are the results of sequential changes, that they have histories. Sedimentary strata now cover the sea floor and much of the land area—in fact more than 90 percent of the earth's surface—reaching a thickness in places of several miles. They contain the fossil remains of bygone plants and animals and other records of a long history of past conditions and events. Their present average rates of accumulation are well known. These rates, of course, vary greatly from place to place, but they are consistent with the conclusion that many hundreds of millions of years were required to erode the lands and deposit the resultant material to form the sedimentary record. This record is made accessible by deep borings and deep erosion, especially in mountains where miles-thick sequences of sedimentary layers are often exposed to direct examination.

The second milestone in the formulation of historical science was the publication, in 1796, of *The Theory of the Earth*, an epochal work by the Scottish naturalist James Hutton. Hutton independently rediscovered Steno's method of analyzing the evidence of sequential steps in past events. He adopted the Newtonian view that God has always acted through natural laws and that the majestic works of nature glorify Him and attest to His existence. He rejected the possibility of repeated divine control of events as undemonstrable, speculative, and unnecessary. Instead, he showed that known physical causes—gravity, erosion, sedimentation, heat and cold, volcanic eruptions, and earthquakes—are adequate to explain geologic features. His reasoning led him to conclude that the known rates of change, although admittedly variable, would require much more time to build the earth than the 6,000 years allowed by theologians. Geologists have come to think of this orderly application of natural laws in geologic evolution as *uniformitarianism*, or simply as uniformity of process—the present is the key to the past. A modern corollary is that the past can teach us much about the present and the future.

Hutton's principle was adopted and broadly illustrated by Charles Lyell, a compatriot and contemporary of Darwin, in his three-volume *Principles of Geology*, which became a standard work on stratigraphical and paleontological geology. While lying seasick in his hammock on the outward-bound *Beagle*, Darwin read the first volume, published in 1830, in which Lyell argued that the earth's contours were not shaped by the Flood but by the action of rain, wind, earthquake, volcano, and other natural forces. "No causes whatever have from the earliest time to which we can look back, to the present, ever acted but those now acting and they have never acted with different degrees of energy from which they now exert," Lyell wrote.

Fundamental clues concerning past life and earth history were also provided by William Smith, an English surveyor, engineer, and practical field geologist, who discovered that changes in kinds of fossils could be used to determine the sequence and relative ages of the deposits in which they were found. In 1815 he published the first geologic map of England, which showed that each individual stratum contained "organized fossils peculiar to itself." The strata, he found, were arranged in a particular and fixed sequence over large areas. This discovery, subsequently confirmed over the world, makes it possible to classify strata by geologic age and to date past events in chronological order. These facts of the fossil record are satisfactorily explained by evolution, not by the creation idea.

Geologists before Darwin's day thus learned to identify the geologic ages of strata by their distinctive assemblages of fossil remains, especially those of extinct but abundant marine organisms. The outline of a worldwide system of classification of geologic strata and their ages based on the vertical sequence was completed early in the nineteenth century and is now routinely employed for geologic mapping, the search for mineral deposits, and for the correlation of past events in the physical and biological evolution of the earth. All of this development depended on worldwide changes in life.

At about the time Smith was making his discoveries, Georges Cuvier, a French naturalist, was busy classifying fossil remains unearthed in excavations in and around Paris. Based on what was known of comparative anatomy, he organized ancient shells and bones into a chronological succession of genera and species, among which he counted about ninety that had disappeared from the earth. What had caused their extinction? Unable to reconcile his finding of successively vanished worlds with the dictates of fundamentalist principles and unwilling to abandon his faith in special creation, Cuvier embraced the doctrine of catastrophism, a popular nineteenth-century theory, which deemed that it was not the Noachian Deluge alone but a series of cataclysmic events that reshaped the earth and destroyed former species. According to Cuvier's version of catastrophism, extinct species were replaced by migrations from other regions. Other contemporary catastrophists, impressed by consecutive changes in whole faunas and floras, believed that each catastrophe was followed by new acts of creation. Many of today's creationists are even more conservative than their nineteenth-century forerunners in their insistence on a single burst of creation and a single catastrophe—the Flood.

Hundreds of alternating assemblages of land and sea organisms, of which all but the youngest are extinct, have been traced over the world. They tell not simply of one flood, but of many advances and retreats of the sea over portions of each of the continents. Buried remains of still-living species of animals and plants, although quite numerous in the earth, are found only shallowly buried within a few feet of the present surface in still unconsolidated sediments. They form a very small and inconsequential part of the fossil record. This agrees with the conclusion of paleontologists that the modern biota does not extend back into the deeper strata believed to be more than twenty-five million years old. If these species had been created together with all other forms of life, as the creationists say, they would occur throughout all abundantly fossiliferous strata—representing 600 million years of earth history—from bottom to top. They do not. The thousands of fossil species that extend through vertical miles of strata below the records of still-living species belong to wholly extinct species of organisms that show successive vertical changes through the rocks. They include many forms that clearly are to be classified in the same major groups with modern organisms of which they are presumed to be the ancestors.

For several decades, geochemists have been dating events of earth history by means of the constant rates of decay of radioactive isotopes. This is the radiometric method. Carbon 14 is effective in dating objects up to 50,000 years old. Using radioactive isotopes of uranium, thorium, potassium, rubidium, and other elements the time scale can be extended back far beyond the 600 million years of the abundantly fossiliferous part of the record.

As radiometric methods have been refined and combined with other methods of relative dating provided by rocks and fossils, overall precision and reliability have steadily improved. An accuracy of plus or minus 10 percent of the age, in years, is routine for good samples. The radiocarbon method of dating has recently been greatly improved by cross-checking radiocarbon analyses with overlapping suites of annual growth rings of trees.

Among the phenomena that impressed Darwin, as it had other naturalists engaged before him in classification of organisms, was the variation in form within single populations and the underlying similarity of structure among quite different species. To the creationists, variation, as explained in the biology textbook of the Creation Research Society, "is simply an expression of the Creator's desire to show as much beauty of flower, variety of song in birds, or interesting types of behavior in animals as possible," presumably for the delectation of human beings. Similarities are attributed to the fact that "the Creator chose to use a common pattern" in his separate acts of creation. Organic evolutionists, on the other hand, attribute variations to genetic recombinations and mutations. Similarities in form, structure, and DNA proteins are believed to indicate a common origin and the descent of one species from another.

Much chemical and genetic evidence exists of the essential unity of life on earth. For example, one or both kinds of nucleic acid, DNA and RNA, by which heredity is encoded, stored, and retrieved, carries the genetic message in every organism from viruses and bacteria to man. These complex nucleic acid molecules are paired spiral chains of nucleotides wound around a common axis to form a double helix. The nucleotides vary in sequence within the chains. The number of nucleotide pairs in a single gene, or hereditary factor, may range into the thousands, giving the genes the potential for a variability so immense that it probably exceeds the realized diversity of all the organisms that have ever lived on earth.

Only four kinds of nucleotides—or genetic "letters"—are employed to spell out the genetic code—or "words"—of the chromosomes. Evolution has been guided by the formulation of new words, created by sexual reproduction or recombination and mutation, that pass the test of natural selection.

In rejecting the concept of evolution *in toto*, the special creationists, who still maintain the earth is only 6,000 years old, level many criticisms against it. Chief among them are these: enough time does not exist for major evolutionary changes to have taken place; gaps between major groups exist in the fossil record; there is a tendency for whole groups of species to appear suddenly, contrary to what one would expect in evolutionary development; the orderliness of nature could not come about by natural means; and, finally, organic evolution is not a fact but only a theory that has never been proved.

Estimates of the earth's age and the methods of geologic dating have already been explained. Lacunae and aberrations in the fossil record are answered by the explanation that the earliest population of any new group consists of very few individuals, the chance of their being preserved is therefore negligible. The order of nature is far from perfect. What order exists, conforms to the action of known natural laws.

As to the last criticism, there is no argument. Evolutionists willingly concede that their explanation of evolution is a "theory." It is, however, an organized explanation, a conceptual scheme that satisfies the facts as presently known. The evidence on which evolutionary theory is based is indeed factual, overwhelming in quantity and variety, and abundantly proved. If organic evolution is defined as profound changes in organisms throughout the history of life, then evolution may be accepted as a fact. But like everything else in science, the theory of organic evolution is open to revision should new evidence appear.

The evolutionists, for their part, dismiss special creation not only because it flies in the face of centuries of accumulated knowledge but because it violates the spirit of science by substituting supernatural explanations for empirical evidence. The doctrine of special creation is theology, not science. As the National Academy of Science put it in protesting the lobbying tactics of the special creationists:

> The result of including creationism in otherwise nonreligious textbooks would be to impair the proper segregation of the teaching and understanding of science and religion. The foundations of science must exclude appeal to supernatural causes not susceptible to validation by objective criteria. Science and religion being mutually exclusive realms of human thought, their presentation in the same context is likely to lead to misunderstanding of both scientific theory and religious belief.

To those who think that the battle over evolution was settled in the Wilberforce-Huxley debate in 1860, or in the Scopes trial in 1925, one can only repeat the words of philosopher-poet George Santayana: "Those who cannot remember the past are condemned to repeat it." ☐

Comfortable Old Shrines; Divisive New Visions

In present-day Spain, reports of the Virgin's appearance may attract large crowds, but is belief strong enough to support a shrine in her memory?

Text and photographs by Jerome R. Mintz

The ancient Spanish shrine of María de los Santos, situated in wooded countryside three and a half miles outside Alcalá de los Gazules in the province of Cádiz, is believed to date back to the period following the reconquest of the Moors in the fourteenth century.

Legend has it that the shrine came into being when a shepherd guarding his flock discovered a doll-like image of the Virgin beneath a palm bush and put it in his sack to take home for his daughter. But upon arriving at his house, he found that the image had disappeared. Returning to the original spot, he saw it lying under the same palm bush. Again he placed it in his sack, and again it had disappeared by the time he reached his home. The shepherd's son then went to investigate, and he too saw the image of the Virgin under the bush. He summoned his father, but by then the Virgin had disappeared.

The site was first marked by a cross carved with the words *santo, santo, santo,* after the benediction said there. Later these words gave birth to the name María de los Santos, Maria of the Saints. Eventually, a small chapel was built, and the shrine became noted for its cures and other miracles.

Between the seventeenth and eighteenth centuries a larger chapel was constructed to shelter the Virgin, together with an adjacent hostelry to house the worshipers. Visitors and donors could remain there to enjoy the air or simply to rest on the day of the yearly pilgrimage.

Over the centuries, scores of paintings, along with crutches and canes, have come to crowd the walls of the chapel as testimonies to the powers of the Virgin of Alcalá. Most of the paintings illustrate miraculous cures from grave illnesses. Some mirror dramatic escapes from bandits or soldiers; others depict salvation from drowning, falls from horses, and encounters with bulls or, more recently, with automobiles. Many of the paintings faithfully reflect the emotional content of the stories. The aura of devotion and the primitive perspective and form of the paintings are reminiscent of the early Middle Ages. Recently, photographs re-enacting miracles have been tacked on the wall next to paintings done centuries earlier. The paintings are often inscribed with such explanatory messages as:

> On the 22 of December 1815, five shots were fired at Don Fernando Velasquez who commended himself to Our Lady of the Saints and through her intercession he was not struck.
>
> José Garcia Berdolico found to be seriously mentally ill was commended by his wife to Our Lady of the Saints and was cured in the year 1860.
>
> Ynes Gautie, gravely ill, was commended to Our Lady of the Saints by his wife and his mother and became well. 1878.
>
> Antonio Benitez Solot fell accidently from the third floor of a building under construction in Marbella, April 16, 1971, and was unharmed, with devotion to Our Lady of the Saints.

On various occasions the townspeople have collectively sought the Virgin's aid. In the past, when drought threatened the crops, the men of Alcalá would shoulder the red-mantled Virgin, carry her down to the Barbate River, and enter it up to their chests, while others threw water into the air and shouted, "Let it rain, Maria of the Saints." This practice was discontinued in the 1940s, when, in the words of one worker, "the radio gave weather forecasts."

There are some townspeople who scoff at the Virgin's supposed powers, but the day of the annual *romería* (pilgrimage) in September attracts a wide range of participants—ardent believers, those concerned with their place in the social organization of the town, and many who just enjoy a good feast. Revelry more than rivals piety on this day.

A meal is furnished for the poor and any other guests who wish it. Many bring wine and beer, and families, courting couples, groups of teen-agers, and children flock to the site. Groups with guitars and castanets come from other towns and cities. So happy and festive is the occasion that many in the crowd do not even notice when the doors of the chapel open, and the Virgin is carried down the steps and paraded around the shrine.

While Andalusian women are noted for their worship of the Virgin and far outdistance men in piety and attendance at mass, it is

At the annual pilgrimage to the shrine at Alcalá, traditional Andalusian dances are part of the festivities.

the men of Alcalá who maintain the shrine. The brotherhood of the Virgin provides funds for the shrine, arranges for the pilgrimage, and prepares the meal for the poor and guests.

The brotherhood embraces every class, but the brotherhood's organizing junta is elected to office, and its members belong to the town's upper and middle classes. The four principal officers are a veterinarian, a banker, a doctor, and a schoolteacher, and the six members of the executive committee have similar occupations. The men who carry the Virgin in the procession, however, are generally woodcutters and construction workers.

There are no dues in the brotherhood, and the sanctuary is maintained by donations, particularly from wedding parties and from those who use the guest rooms on the day of the *romería*. Each of the large landowners in the brotherhood donates a cow, which is then maintained on the land of another landowner. Money from the sale of the male yearlings and, eventually, from the sale of the cow itself is given to the brotherhood. The sanctuary's herd now totals forty animals, and the accumulated income is more than sufficient to support the shrine. Extra income has built housing for the poor, and a resident school for children who live in the countryside is being constructed.

While the men of the town generally join in devotion to the Virgin, they are not necessarily followers of the Catholic church. The reverse is more often the case. As everywhere in Andalusia, it is customary for working-class men to ignore mass and to deprecate the clergy. For most it is inconceivable to confess to another man in order to receive the sacraments of the church.

The attitudes of the clergy toward local shrines vary. Some of the parish priests in Alcalá have considered activities at the shrine as pagan revelry, but rather than affront the emotional followers of the Virgin, they have kept their opinions to themselves. During a period of drought some years ago, the townspeople requested Don Antonio, the priest, to lead a pilgrimage to the river. His angry retort was, "Do you think that the Virgin is a faucet that you can turn on whenever you need water?" But he yielded to their pressure.

When he reproached people for believing in something they could not see, they responded, "Don't you tell us to believe in God? But you can't see Him. If one believes in the supernatural, there's no reason why one can't believe in saints and the Virgin and in witches too." When Don Antonio persisted in opposing the worship of the Virgin, the bishop was petitioned to remove him, and he was transferred.

Throughout Spain, occasional sightings of the Virgin continue to be reported, but it is difficult to establish a new shrine and institutionalize a brotherhood. The shrine at Palmar de Troyas, about 120 miles north of Alcalá in the heart of Spain's olive- and wheat-growing region, is one of two new shrines initiated in that country during the last five years.

On March 30, 1968, four young girls claimed they had seen the Virgin while gathering flowers in an open field a short distance from the town. The oldest, a seventeen-year-old, remained in a state of faint for several days. On a number of occasions the girls returned to the field and again reported seeing the Virgin,

Awaiting the coming of the Virgin at Palmar de Troyas, top, women hold bottles of water to be blessed. A crowd gathers, above, as a woman tells a priest that her mother has just seen the Virgin. Laborers at Alcalá, left, carry the Virgin's statue around the chapel. It is so heavy, they must rest every few yards.

but they were so overwrought after their visits that townspeople say two of the families moved away to prevent their daughters from returning to the field. Subsequently, six adults also reported seeing the Virgin.

In April, 1970, one of the visionaries reported that the Virgin had appeared to him in the field and had told him to "have all the sick here on the 15th of May. I will appear at five o'clock. I won't make any promises, but perhaps there will be a miracle." News of the forthcoming event was spread throughout Spain by word of mouth. Soon posters were tacked up in cafes announcing bus tours to the site on that day.

By 10:00 A.M. on May 15, a hundred or so people had already gathered in a clearing in the field. In the center of the clearing a small pedestal with glass-enclosed portraits of Christ and the Virgin had been set up. The immediate area around the pedestal was roped off, and people queued up to kiss the pictures. The crowd grew as two busloads of people arrived from Granada and as others drove up in cars.

Small groups of women stood together holding bottles of water they had brought to be blessed. There were a few nuns and a lone, elderly priest, who listened to a young woman describe how she had seen the Virgin and had asked her to cure her mother: "The Virgin blessed the water I was carrying. I gave the water to my mother and she was immediately cured. Then I gave the water to others who were sick and they too have been cured."

Groups gathered around those who claimed to have seen the Virgin. They all told similar stories, but some recalled the clothing worn by the Virgin, while others mentioned the distinctive odor of flowers. One man had seen and photographed a strange light.

In the crowd were many who had come out of curiosity and some who were clearly skeptical. One man from Madrid, wandering aimlessly through the field, said he had brought his wife because "she has a passion for these things. We've been to Fátima and to all the shrines. She is obsessed. This is the way it is with the women of Spain. We've been here four or five days. My wife is waiting for the Virgin to appear. Myself? I'm waiting for it to rain." He pointed to the overcast sky.

In the early afternoon microphones and amplifiers were set up in the roped-off enclosure. Using a battery-powered megaphone, one of the young men directing the affair announced: "We're not doing anything. All will be cured by God. Long live the Pope. Let us pray for the conversion of the Russians." A woman about sixty years old fell into a trance, and the expectant crowd waited for the Virgin to appear but nothing happened.

During the late morning and afternoon a rising tide of the sick and maimed struggled up the path toward the portraits of Jesus and Mary. A small boy in a wheelchair was pushed up the bumpy path close to the enclosure, and the crowd pressed in tightly. "Don't step on him!" his father shouted anxiously. The young man with the megaphone ordered: "Those who want to have water blessed, line up—the sick in front, the healthy in the rear."

Five o'clock came and went without an appearance by the Virgin. The crowd waited patiently, shielded from the hot sun by a blanket of multicolored umbrellas. Just before six o'clock a number of women fell into brief trances, their eyes momentarily vacant. After recovering, one woman remained in a half-swoon, and people flocked around her, taking from her neck some of the many strands of rosary beads she had worn in anticipation of her spiritual contact. As people reached out to touch her, she told them: "I asked for health for all the sick."

In the early evening the crowd grew so large that latecomers could not approach the small enclosed area where the pictures of the Virgin and Jesus were displayed. At eight o'clock the voice on the loudspeaker asked for silence—some people were receiving messages from the Virgin. The silence lasted several minutes and then was broken by a cry. A miracle had occurred! A mute child had spoken. She was raised like a banner above the crowd and passed from hand to hand. The hysteria of the crowd did not seem to affect the child, however. She remained unnaturally calm, and those standing nearby said that she did not have the face of a cured child.

This miracle touched off others like a series of firecrackers. Word rippled through the crowd that a cripple had been cured and also a blind man. A lame boy was said to have risen from his wheelchair. One family urged a paralytic woman to get out of her wheelchair: "Get up! Get up!" they urged, helping her to her feet. She struggled to stand and then fell back.

Not everyone was favorably moved by the events at Palmar de Troyas. Cardinal José María Bueno Monreal, Archbishop of Seville, severely critical, called the reports of the visions manifestations of hysteria and superstition rather than of the supernatural, and forbade the priests of the diocese to conduct mass there.

Since the first flurry of visionary experiences in the town, there have been no new local visionaries. The number of local supporters remains small, and most townspeople are skeptical. The four young girls who originally reported the visions have either moved away or are being kept quiet by their families. Many people in the area question the experiences that have been reported. "If you don't see it, then you don't believe. They say they saw it. Who knows?"

Some have tried to test the claim of a supernatural presence in the field but have failed. One said, "I thought there might be something to it, and since I have heart trouble I went. It was at three in the morning. I was scared to death at that hour of the night. There's nothing there. I saw nothing."

Visitors continue to come from elsewhere in Spain and from other parts of the world, and mass is said by foreign priests who are not under the ban issued by the cardinal. Funds have been raised in Seville to improve the shrine. One donor erected a large statue near the public roadway and put up a fence. Another dreamed that God told him to dig three wells nearby. The first two failed, but the third provides enough water for the flowers that decorate the shrine. The original owner of the field, discouraged by the worshipers who ruined his crops, sold the land to a woman in Seville who is sympathetic to the pious trespassers. She is reported to have said: "If it is established that the visions are from God, I will build a chapel and there won't be any lack of money, but if it is a lie, I will get rid of everything."

Among the half-dozen adults in Palmar who claim to have seen the Virgin are Francisco and his wife, Ana. The front room of their house is cluttered with drawings, paintings, and statuettes of the Virgin and of Christ. Francisco appears unlike his fellow *campesinos*—he is heavily bearded and seems overcome with ennui. He says that it is difficult for him to speak of what has happened since 1968, when the Virgin was first seen.

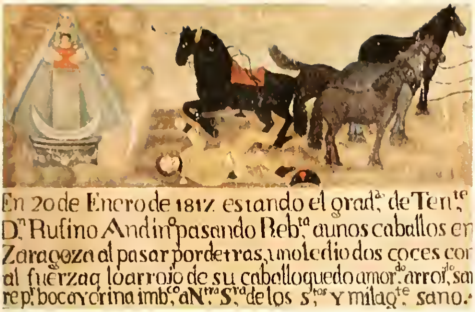
Francisco's wife, a large woman with a soft, set smile, says that she continues to see the Virgin every day. Francisco says that he has seen the Virgin and spoken with Jesus, but that neither has appeared to him in a long time. "I want to see the Virgin again. Before I saw her, and now she doesn't appear to me. I want her to take me away. When something supernatural happens to you, then you don't care for this earth any more. No one on earth has the right to walk before God. We are filled with sin. But when my wife asks her, the Virgin answers that it is still too soon for her to take me.

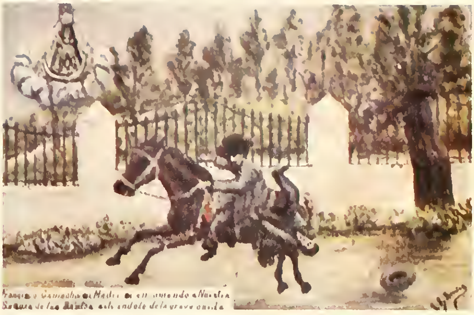
"Jesus told me to grow the beard. 'Francisco, grow the beard. As happened to me will happen to you. People will make fun of you, will mock you.' And they do. Those in the town laugh at me. People in cars call me names. My children no longer know me. They do not come here. They don't speak to me on the street."

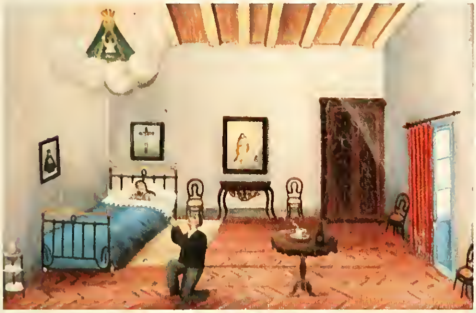
Ana adds: "Our four children do not speak to us or visit us. We have seen the Virgin and are involved with her. They don't believe."

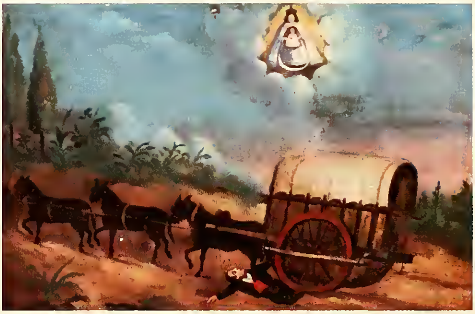
The role of the shrines in the lives of the two towns reflects dif-

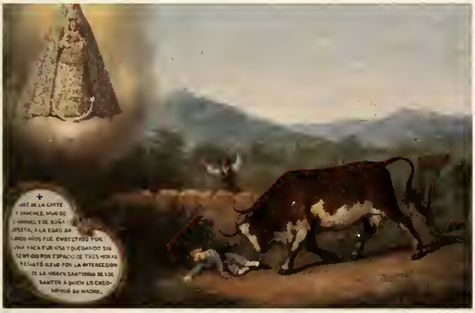
Two walls of the chapel at Alcalá are covered with religious paintings, which date from the seventeenth century to the present. Most depict the power of the Virgin to effect miraculous cures or escapes from accidents. Photographs of the sick have recently been added to the walls.

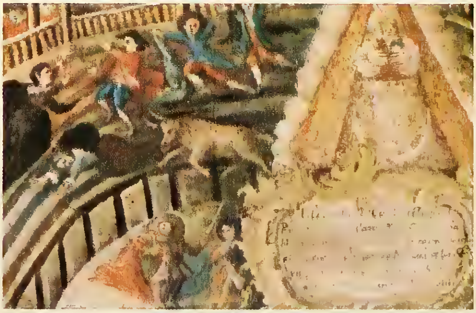

En 20 de Enero de 1817 estando el grad.^a de Ten.^te
D.^n Rufino Andin.^o pasando Reb.^ta a unos caballos en
Zaragoza al pasar por detras, uno le dio dos coces con
al fuerza q lo arrojo de su caballo quedo amor.^do arrol.^tdo san
re p.^r boca y orina imb.^co a N.^tra S.^ra de los S.^tos Y milag.^te sano.

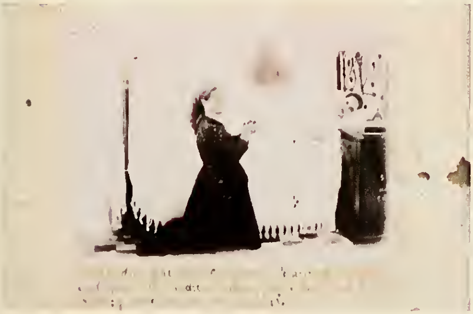


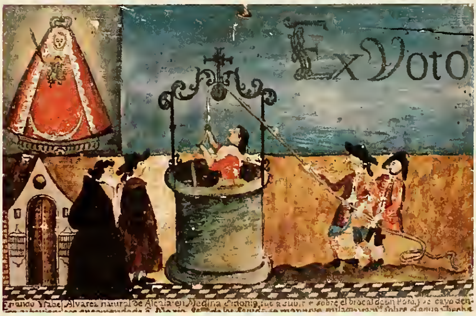





✝
JOSÉ DE LA CORTE
Y SANCHEZ, HIJO DE
D. MANUEL Y DE DOÑA
JOSEFA, A LA EDAD DE
CINCO AÑOS FUÉ EMBESTIDO POR
UNA VACA FURIOSA Y QUEDANDO SIN
SENTIDO POR ESPACIO DE TRES HORAS
RESUCITÓ ILESO POR LA INTERCESION
DE LA VIRGEN SANTISIMA DE LOS
SANTOS A QUIEN LO ENCO-
MENDÓ SU MADRE.






Ex Voto
Alvarez natural de Alcala en Medina Sidonia, que a subir e sobre el brocal de un Pozo, se cayo den-

In a field at Palmar de Troyas, two women pray for the Virgin to appear. At right, people struggle to touch the rosary beads of an elderly woman who has just had a vision.

ferent stages of belief, organization, and attachment. Over the centuries, the Virgin of Alcalá has been called upon to resolve the town's collective problems as well as the needs of individuals. Belief in the *patrona* is closely tied to local and familial loyalty, and she is considered an extension of the family. For generations townsmen have been taught from childhood to turn to her in moments of doubt and desperation. Children are taken to see the Virgin when they are baptized, courting couples visit the shrine, marriages are performed there, and there are annual pilgrimages. The townspeople pray to her, dress her in resplendent robes, feed the poor in her name, name their children after her, light candles to her, boast of her, and promise to do penance for her. Even if their childhood faith dims, they continue to maintain their loyalty.

For her part, the Virgin comforts her flock and softens the calamities of illness and accident. Of course, there are similar shrines only a few miles away, but the townspeople feel a special kinship to their Virgin. As the saying goes, even with her hands tied behind her back, the Virgin of Alcalá can perform more miracles than the Virgin of Vejer.

The brotherhood supports needs other than spiritual ones. A role as officer or committeeman or a place in the procession provides status, merit, and identity with the community. The money raised by the brotherhood supports the shrine and aids the poor. Since the shrine exists apart from the Catholic church, townsmen can express religious or festive feelings without compromising their anticlerical sentiments. In sum, there is a network of secular and religious support for the shrine of the Virgin of Alcalá that extends across class lines and includes persons of diverse religious opinions and motivations.

In contrast, the shrine at Palmar rests on a much narrower ideological base—the visionary experience. The first visions of the children at Palmar startled the town and stimulated visions in a small number of adults. Thus far, however, the visionary experience has been exclusive rather than inclusive. While such visions may have had cathartic or therapeutic effects for the individuals involved, they have proved to be disruptive to the community and, ultimately, consuming for some individuals. The visionaries, it would seem, have overreached themselves, and their supernatural experiences have become increasingly suspect. As a result, the shrine has been in great measure divisive, separating the visionaries from the rest of the community and causing severe strain in some families.

The shrine has also been divisive in other respects. News of the visions drew many worshipers from outside the town, and for a short time its leaders basked in their town's notoriety and importance.

Continued on page 85

The Deflowering of Central America

Because its species are highly specialized and intricately interrelated, a tropical ecosystem under human assault quickly collapses

by Daniel H. Janzen

"Did you hear about the fantastic bat netting at the COMELCO ranch? We caught twenty-one species in four hours."

"Well, you could have done that right out back five years ago."

"What would you get now?"

"Maybe five, maybe seven."

I overheard this conversation between three biologists who were conducting bat longevity studies at Finca La Pacifica, a ranch in the prime cattle-raising and cropland region of Guanacaste Province in Costa Rica. Two of them had just returned from banding bats at COMELCO, a larger, corporation-owned ranch, thirty-five miles away, and the site of one of the two remaining remnants of relatively large, undisturbed lowland deciduous forest from Guatemala to the Panama Canal Zone. (The other, also in Guanacaste, is in the Parque Nacional Santa Rosa.)

The COMELCO tract is now in the process of being cut and bulldozed in order to create more pastureland for the approximately 100,000 head of cattle that roam wild there. Five years from now, some biologist might repeat the last half of that conversation, but he will probably be studying bats at COMELCO instead of at Finca La Pacifica.

Foraging male Eulaema tropica *bees visit a* Catasetum *orchid in Oaxaca, Mexico. The flowers are fertilized through an exchange of pollen, which adheres to the bees.*

Examples of the local or total extinction of Central American species through habitat destruction are recounted ad nauseum by those studying the animals and plants in these vaporizing habitats. For example, in 1965 I collected thirty-two species of wild bees, totaling about 1,500 individuals, from the flowers of an *Andira* tree (known locally as carne asado) in Guanacaste Province; in 1969 I collected four species, totaling twenty-three individuals, from the same tree at the same time of year. In 1965, at the same site, I dispatched two howler monkeys that had been crippled by a car while crossing the Pan American highway; today there are no more howler monkey road-kills in this area—the forest habitat of the howler has been destroyed for miles back from the highway.

What escapes the eye, however, is a much more insidious kind of extinction: the extinction of ecological interactions. Many of the remaining participants of these interactions will probably hold on for many years, but they constitute little more than a haphazard, semi-self-sustaining zoo and botanical garden. Their complex behaviors, morphologies, and physiologies seem unnecessarily complex, even maladaptive, in the defaunated fencerow-pasture-field habitats they now occupy. And I use the word "occupy" advisedly: for example, many tree species, represented by mature individuals left when the forest was cut, exist only by virtue of their longevity.

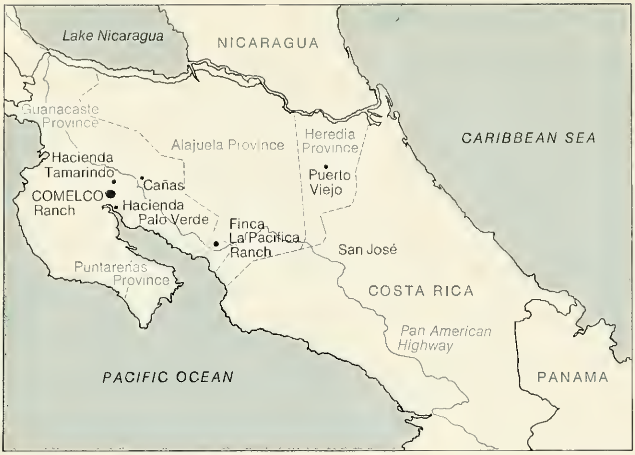
The extinction of an interaction system occurs in many ways, but there is one consistent characteristic: the animals and plants involved no longer interact in the manner that originally led to selection for the production and maintenance of the traits they now display.

An esoteric, yet in many ways representative, example illustrates this point. During the dry season (January to the end of April) of 1970, I collected about 7,000 seed pods from about twenty-five guapinol trees (*Hymenaea courbaril*, Leguminosae), most of which were growing in fencerows, open pastures, and river-edge forest, and along roadsides. Remnants of a once extensive forest, the trees were generally fifty or more years old. In approximately 50 percent of the pods collected, the seeds had been infested by the larvae of a large weevil, *Rhinochenus stigma.*

This weevil has one important characteristic: When the larva is mature, it excavates a cavity almost, but not all the way, through the very hard pod wall and then pupates inside the pod. The adult weevil hatches about the time the pod falls from the tree, completes the cut through the pod wall, and then disperses into the habitat.

I collected the pods directly below the guapinol trees and gave little thought to the meager evidence of dispersal agents below the tree, such as rodents that chew into the pods or deer that break open the pods with their feet. Such animals would be the principal means by which the heavy pods and seeds could be scattered to new growing locations.

DANIEL H. JANZEN



However, 18 of the 7,000 pods contained another species of a closely related, but undescribed, *Rhinochenus*. The larvae of this weevil pupated without first cutting an exit hole through the hard pod wall, and in all but one of the 18 pods, the newly hatched adult weevils had died of starvation. My past experiences with seed predators had led me to believe that they are not likely to exist at such a low density. Since the adult weevils of this species did not have the behavior appropriate for escape from the pod, I speculated that this was probably an example of an incorrect host. But my search for an alternate host was fruitless; in Guanacaste Province there are no other trees with pods even vaguely resembling those of the guapinol.

Then while browsing in the British Museum of Natural History's Central American weevil collections made by George C. Champion at the turn of the century, I found that he had collected many of the now rare *Rhinochenus* at one of my collection sites, but had found only a few *R. stigma*. Champion was a careful collector with a reputation for accurate labeling. Obviously many changes have occurred in the six decades since Champion did his collecting; for one thing, the population of large terrestrial rodents, primarily agoutis and pacas, had been all but eliminated by hunting and habitat destruction.

I was left with the speculation that large rodents had to open the pods for adults of the rare *Rhinochenus* to escape. This hypothesis is substantiated by the observation that when a pod containing this weevil is opened, the adults run rapidly away from the pod in all directions; an adaptive item of behavior because pacas and agoutis are insect- as well as seed-eaters.

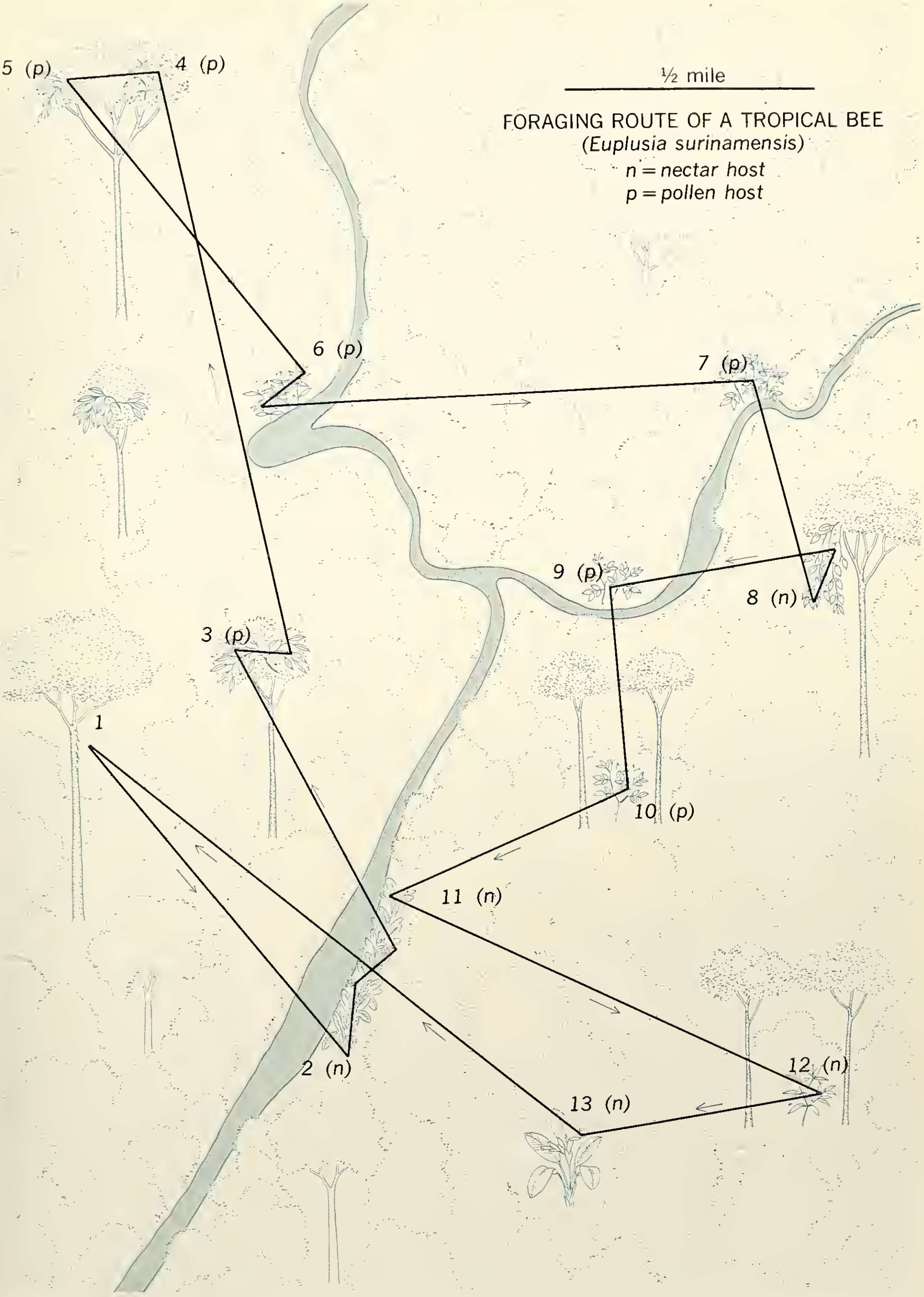
To test this idea further, I searched out several guapinol trees growing in small tracts of forest where agoutis and pacas were still present. In samples of these seed pods the "rare" *Rhinochenus* was by far the more common species and *R. stigma* was extremely rare. It thus appears that in areas where agoutis and pacas are heavily hunted or their habitat destroyed, the currently rare, undescribed *Rhinochenus* is still present only by virtue of occasional immigrant females flying in from remnant bits of semi-intact forest. In the forest, however, it outcompetes *R. stigma* to such a degree as to completely reverse their relative abundances. In short, over most of the guapinol population in Guanacaste Province, the undescribed *Rhinochenus* is extinct because of the elimination of large rodents. We can predict that *R. stigma* will disappear next, as the old remaining adult guapinol trees are thinned out by lumbering to the point where they are too far apart for the weevils to fly easily from one seed crop to the next.

Future field ecologists may also be misled on an important aspect of guapinol physiology. Like many tropical tree species, a specific guapinol does not bear seeds every year. There is a considerable body of theory and evidence that suggests that this genetically determined behavior is an adaptive mechanism. For example, if the weevils that locate a particular guapinol produce enough larvae to destroy the seeds in, say, 200 pods, then a tree that produces only 200 pods each year will have no surviving seeds, but a tree that produces 400 pods every other year will have a 50 percent seed-survival rate in terms of seed predation by weevils.

When I first started keeping records on fruiting periodicity of the guapinol, most of the trees under observation were growing in pastures, fencerows, and roadsides. As expected, only one-third to one-fifth of the trees bore fruit in 1969, the first year of observation, suggesting that the trees had a three- to five-year interval between fruit crops. However, I discovered that some of the same trees again bore large pod crops in 1970, and a few even fruited again in 1971.

A consideration of the mechanism for fruiting leads to a possible solution. A normal guapinol tree growing in a forest is under severe lateral crown competition from ad-

In Costa Rica Euplusia surinamensis, *a typical bee species, memorizes and flies this hypothetical foraging route, or trapline, to collect nectar and pollen from flowering plants. The nest (1) is constructed 130 feet above the ground under the loose bark of a tree. Ground plants (2, 11, 13), shrubs (6, 7, 9), understory trees (10, 12), vines (3, 5, 8), and an epiphytic shrub (4) are visited daily.*



FORAGING ROUTE OF A TROPICAL BEE
(*Euplusia surinamensis*)
n = *nectar host*
p = *pollen host*

½ mile
1
2 (n)
3 (p)
4 (p)
5 (p)
6 (p)
7 (p)
8 (n)
9 (p)
10 (p)
11 (n)
12 (n)
13 (n)

CHARLES CLARE

jacent trees. The same applies to its roots. Therefore, only a small fraction of the total photosynthate (products of photosynthesis) produced each year can be stored for eventual sexual reproduction; the remainder is expended in maintenance metabolism. The tree contains a triggering mechanism that initiates fruit production in the year when its reserves have accumulated to the point of permitting maturation of a single large pod crop. The size of this crop and the time period between crops is determined by natural selection; the amount of gain in seed survival through waiting one more year is balanced against the loss in sapling production by not putting new seeds into the habitat each year.

This pattern continues until someone cuts down the neighboring, competing species that keep the sun from reaching all but a small part of the guapinol's crown. The crown then gets more laterally oriented sunlight, and the tree responds with greater leaf production. The seed-triggering mechanism is probably short circuited in the following manner: In the first sterile year after the last pod crop, the tree stores as much photosynthate as normally accrues only after two or three years in a forest. It then produces a seed crop and probably even accumulates enough reserves during that year for another full pod crop. Exceptionally isolated trees may be able to keep this up for three or four years, before becoming sterile for a year or two to build up reserves again.

Therefore, a guapinol tree deprived of its everyday interactions with neighboring trees is, ecologically, highly abnormal, and difficult to use as a model for understanding the coevolution of the tree and its seed predators. The situation is akin to attempting to understand the evolution of the foraging behavior of bears by watching them open garbage cans in a national park.

The tropics abound with other examples of the extinction of an ecological interaction. The stately *palma real (Scheelea rostrata)* in Guanacaste Province is worth noting. This palm was once abundant in swamp forests and on moister adjacent hillsides through the lowland forest. Because its habitat makes outstanding pasture, the forest was cleared. Numerous adult palms were left standing, however, because they cast little shade on the grass and cattle chew the edible pulp off the nuts. One is led to believe that here is one tree that will survive human activities. Not so, for unless a rodent ventures far into the pasture and takes a seed into the forest, the palms in the pasture are stone dead as far as any future population is concerned. Their seeds fall, germinate, and grow into healthy seedlings during the rainy season; but when the dry season comes, they die of drought in soil that is fully exposed to the sun.

The destruction of interspecific interactions by human habitat exploitation is by no means restricted to those tropical areas where much of the land has been cleared for farming. The following example from the Costa Rican rain forest is only one of many that could be cited.

Traveling during the early hours of the morning along roadsides and trails near the old town of Puerto Viejo in Heredia Province, one occasionally sees large female bees visiting the flowers of low roadside shrubs. These individuals, of the species *Eulaema cingulata* and *Euplusia surinamensis*, are removing the pollen from the tubular anthers of, for example, *Cassia* (a legume) and *Solanum*, a plant in the potato family. These bees and plants are common inhabitants of weedy areas in the lowlands from southern Mexico to Panama.

If we could follow these bees about in contemporary, badly disturbed plant communities, we would find that they fly from their nests to clumps of flowering *Solanum*, *Cassia*, *Bixa*, and *Conostegia*, collect the pollen, and then return to the nest. We would see almost nothing to indicate the important role that they—and many other euglossine bees of the family Apidae—played in the primary forest from which the fields and pastures were cut.

In the primary forest, these long-lived bees were in great part responsible for outcrossing many species of woody plants that occurred as widely scattered individuals in a very diverse forest. The general foraging pattern, as pieced together from circumstantial evidence in many Central American forests, was as follows: Each day the female bee left her nest and flew a well-memorized feeding route, visiting each of a long series of plants. These plants were often several hundred yards or more apart and the whole of her route covered as much as six to twelve miles. By marking and releasing bees at various distances from the nest, I have found that within an hour some of these bees return to the nest from as far as fourteen miles away. This could mean that they have outstanding homing abilities; it could also be that they had become familiar with this section of forest through memorization of many plant sites. Such familiarity is further suggested by the observation that some returned to the nest with a pollen load.

Each plant visited by these bees produces only one to a few new flowers each day, but flowering may go on for as much as six months. While the bee may have initially located the plant through a search pattern in which flower odor and appearance were important, on its daily visits it returns purely through memory of the site. This was easily determined when the bees returned to the plants after the flowers had been removed.

The basic importance of these bees is that they are reliable outcrossing agents for a large number of tropical plants that normally occur at very low population densities and that have often been thought of as inbreeders because of the great distance between reproductive adults.

However, the opportunity to study the bee's behavior and its effi-

This Costa Rican orchid of the genus Mormodes *is an outcrosser, dependent upon bees for cross pollination.*

ciency as an outcrosser is gone in nearly all lowland rain forest areas under moderate to heavy human influence. As the forest is broken up, nest-site destruction removes part of the bee population. Of more interest here, however, is that the brushy pastures provide large stands of some of the plants that once were widely scattered in the forest or on occasional natural disturbed sites along a river. The surviving bee species now condense their feeding routes to incorporate primarily these plants. Not surprisingly, it is only the more generalist and flexible bee species that can do this, and not surprisingly, these presently are the ones with the widest geographic distribution.

In short, we still see a few of the bees, but they are not doing what they were doing for centuries. We also see some of the plants, and some of them are still reproducing by virtue of an occasional visit by an occasional bee. But we have no idea what effect the reduction of outcrossing will have on the population of the plants.

It is important to note that reduction of the population density of the plants from which these bees obtained food was probably responsible for the extinction of many of the more rigid (specialized) species of euglossine bees. To make a success of a feeding strategy that centers around a feeding route, there must be a large number of plants reliably present; the long flights between plants do not allow much time and energy for searching for new plants. As the habitat is simplified through lumbering, grazing domestic animals, the building of housing, and other human activities, there are bound to be certain areas where the plant species that the bee formerly relied on are absent. This creates a downward spiral. As a bee drops out, the pollination frequency for an array of plant species will decline and the resultant reduced reproductive rate may cause these plants to drop out of the community.

We have not yet touched on a major interaction that disappears when the euglossine bees and their pollen and nectar hosts drop out. Male euglossine bees are the famous "orchid bees" of the New World tropics; many are highly host-specific pollinators of orchids. The natural absence of these bees from most Caribbean islands is probably responsible for the lack of many species of orchids on these islands. While large old trees left in pastures may be festooned with orchids, the pollinators are gone, and since most of these orchids appear to be obligate outcrossers, incapable of self-pollination, they too will eventually disappear. The males of orchid bees appear to travel extraordinary distances to find very isolated plants, but as rain forest destruction becomes widespread, this ability is of little consequence.

There is only one moral to these accounts. All that is green and trees is not a forest. Forests are not random collections of animal and plant species. For a plant or animal to be something other than what it is in a zoo, all of the elements of its ecosystem must be present. The number of still-surviving adults is no reliable measure of how close a particular species is to extinction. ☐

KJELL SANDVED

Celestial

lues to Egyptian Riddles

When an astronomer turns archeologist, ancient monuments are cast in a new light

by Gerald S. Hawkins

When Napoleon Bonaparte set out to conquer Egypt, he took with him thousands of foot soldiers, two thousand cannon, and one hundred and seventy-five scholars—astronomers, archeologists, painters, and poets. The great general's trip was more than a battle for trade routes and colonies; like Alexander and Caesar before him, Napoleon was fascinated by the wonders of ancient Egypt.

Before the first battle with the Mamelukes in July, 1798, he rode across the desert to the pyramids of Gizeh and looked upon the face of the Sphinx. But the drifting sand, high at the time, obscured the monument's total shape. When it was excavated in 1818, the lion-shaped body and the temple between the paws were exposed.

Hewn out of a natural outcrop of limestone at the time of the building of the second pyramid, the Sphinx is 240 feet in length, stands 66 feet high, and the width of its face is 13 feet 8 inches. To delineate the shape of the paws and to repair erosional damage, small blocks were added after the bulk of the statue was carved. The disfigurement of the face occurred in recent times, allegedly the result of practice cannon fire by the Mamelukes. An engraved monolith found between the paws was placed there some 3,500 years ago. It told the story of a prince, who, weary from

BRIAN BRAKE, RAPHOGUILLUMETTE

the hunt, rested in the shadow of the Sphinx and dreamed he was commanded by the sun-god to clear the sand from the monument. In return, he would become pharaoh.

The stela, sometimes regarded as self-justifying propaganda put there after the prince, Thutmose IV, had ascended or usurped the throne, gives some clues as to the beliefs of the ancient Egyptians: "Great and exalted is this figure of the god, resting in his chosen place; mighty is his power, for the shadow of the sun is upon him." The word used for the Sphinx is Hor-Akht, "the sun-god on the horizon."

At the top of the stela is the motif of the sun's disk, wings outspread, ready for its journey across the sky. From the earliest times in dynastic Egypt this motif was placed over doorways and in temples. Its various shades of meaning are still not fully understood. It was a protector, a religious symbol, a pharaonic insignia. But it also represented something more: the pharaoh was born the son of the sun, and the shining orb was personified as the pharaoh when he died. Each ruler attached the sun-god symbol Ra to his name. The pharaoh who built the Sphinx was known as Khafre, and the face is a portrait of the god-king. The body lies precisely east–west; the king's eyes stare due east across the Nile Valley toward the point on the horizon where the gods were thought to dwell.

Is this orientation significant? Using astronomical observations and calculations, astroarcheologists are learning that many ancient structures were oriented to the rising or setting of a certain heavenly body. In addition to offering a deeper understanding of Egyptian religious thought—particularly beliefs concerning man's connection with the sky—such orientations also reveal the Egyptians' great observational and scientific abilities.

Others have suggested that the Sphinx guards the second pyramid, which stands behind it, and the Great Pyramid to the north. These enormous structures, the most massive creations in the span of history, boggle the imagination.

The First, or Great, Pyramid was built by Khufu during his twenty-three-year reign, ca. 2550 B.C. It was built on a square base, 756 feet on a side, chiseled into bedrock that is level to a fraction of an inch. The area of the base is thirteen acres, or seven average-sized city blocks. When complete, the pyramid rose to a height of 481 feet, was cased in flush blocks of white limestone, and may have had either a black granite or gold-covered pyramidion capstone at the apex. Each of the four faces slopes upward at an angle of approximately 51 degrees, 52 minutes. The six million tons of hewn rock used in its construction would, as Napoleon figured, be enough to build a ten-foot wall around the whole of France. Cut into standard-sized bricks and laid end-to-end, the Great Pyramid would reach from the earth to the moon.

Why did Khufu (called "Cheops" by the ancient Greeks) have this monument erected? Since the Great Pyramid corridor was sealed with granite plugs, it was not accessible as a temple. Nor can one say with assurance that it was a tomb, although at first sight it seems to have been intended as one. There is a descending entrance passage; joined to it is an ascending passage that leads to a granite-roofed chamber close to the center of the structure, and in the chamber is a granite, lidless sarcophagus. But the tomb was empty when treasure-seeking Caliph Mamun forced his way through the solid structure in the ninth century. Admittedly, grave robbers could have precursed him, but would they have removed everything, including the mummy, the wrappings, and the wooden coffin? The only possible entrance was a rough-hewn vertical shaft, and the heavy sarcophagus lid, if removed, would have to have been broken into pieces to negotiate the shaft. It is interesting to note also that no mummified remains were found in the main chambers of any of the large pyramids. There is a mortuary temple near the Great Pyramid, so it was in some way associated with death and the afterlife.

Inside the pyramid the walls are smooth and bare, offering no clue as to the purpose of the structure. The only marks are some smoke-written signatures of Roman origin in the lower corridors and a few painted quarry marks, most of which are set upside down within the structure, as if to hide the writing. The hieroglyphs carved over the gables of the entrance of the Great Pyramid were placed there sometime after Champollion had deciphered the Rosetta Stone.

The ancient historian Herodotus was told that 400,000 men labored in three-month shifts for twenty years to make what is a wordless, clueless, geometrical shape that has long been listed as one of the seven wonders of the world. There is no scientific support for the suggestion that the dimensions foretell in a cabalistic way the future of mankind. Nor is the Great Pyramid an observatory—the claim that the ascending passage pointed to the celestial pole is untrue. In design, however, the pyramid does intrigue the mathematical mind. The sides align with the cardinal points—the four principal points of the compass—to an accuracy equal to the resolving power of the human eye. Some scholars relate the slope angle to the irrational number π, although it is perhaps simpler to point out that the pyramid angle, particularly for the Khafre pyramid, is 360/7, or one-seventh the circumference of the heavens, which may be of symbolic significance.

In 1954 a wooden boat was found in a rock-hewn pit south of the Great Pyramid. Three other boat-shaped pits were found near the base of the pyramid, but these were empty. These are another mystery. It has been conjectured that the boat was intended to enable the pharaoh to sail across the sky each day with Ra. Another scholar suggests that the boat awaited the pharaoh, ready to carry him beyond the eastern horizon to the land of the gods.

Built during the reign of Khafre, whose face it portrays, the Sphinx gazes toward the eastern horizon, where the gods were thought to dwell.

ELLIOTT ERWITT, MAGNUM

Zoser's pyramid, at Saqqara, was the first "step" pyramid and the first building ever made of cut stone. Hieroglyphic texts indicate that the step pyramid might have been regarded as a staircase to heaven or as an interchange with the gods, while the smooth-sided pyramids may have represented solid rays of sunshine. A text found in a later pyramid said: "Heaven has made strong the rays of the sun and you can lift yourself to heaven like the eye of Ra." These words are clues to what one feels must be a deeper meaning.

Other Egyptian structures present further mysteries. Some 300 miles south of Cairo on the west bank of the Nile, Amenhotep III built two large statues known today as the "Colossi of Memnon." This is a misnomer that originated with the ancient Greeks, who thought there was a connection between the statues and Aurora's son, the mythical hero who fell at Troy. Each statue, when originally capped with the crown of ancient Egypt, stood nearly four feet taller than the Sphinx. Quarried from a sandstone conglomerate and ferried along the river Nile, these objects were an architectural innovation, replacing the obelisk as a sun symbol.

Earthquakes and sandstorm erosion have defaced the statues, which were probably carved as likenesses of Amenhotep. Excavations have uncovered a temple to the west; its axis passes between the two Colossi. The temple axis, and with it the gaze of the two stone figures, is directed eastward across the Nile Valley in the direction of sunrise.

In the distance behind the Colossi lie the dry, bare hills of Thebes. The foothills are studded with mortuary temples of the New Kingdom Period, which reached its zenith more than 3,000 years ago. In a valley behind these hills lay the richest storehouse of the ancient world—the deep, secret tombs of the Valley of the Kings. Because of a simple accident, Tutahkhamen became the most famous of these pharaohs: his tomb, placed near the spot later chosen by Ramses II, was covered by detritus from the great Ramses' tomb and was thus saved from plunderers.

GERALD S. HAWKINS, FROM "BEYOND STONEHENGE"

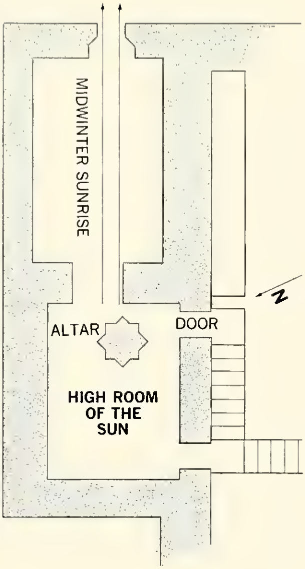
Now partly overlaid by the modern city of Luxor, Thebes, the onetime capital of ancient Egypt, was on the east bank of the Nile. On the northern outskirts of Luxor is the ancient citadel known to the Arabs as el Karnak. Sufficient and careful reconstruction has been carried out to restore its ancient splendor.

The Amon-Ra temple at Karnak was 1,860 feet in length, including the Hypostyle Hall of 12 large and 122 small columns, the quay from the Nile, the avenue of sphinxes, and the so-called oriental temple.

The twelve large columns were 80 feet high and 11½ feet in diameter at the top. On each pillar there were inscriptions and scenes showing the pharaoh and gods. This richly endowed temple, the largest in the world, was built, overbuilt, partially dismantled, and rebuilt over a period of about two thousand years. The most extensive rebuilding began under the reign of Thutmose III, ca. 1480 B.C., at which time the god of the temple was firmly established as a duality of Amon, the "unseen god," and Ra, the sun-god. A computer-aided reassembly of carved blocks showed that the temple was aligned so that the sun may also have been worshiped there as the disk, the all-powerful "Aton," during the reign of Ikhnaton, about one hundred years later.

The temple's axis, straight to within inches, is built to point 117 degrees east of north, parallel to the line between the Colossi on the other side of the Nile. Other temples, as well as the High Room of the Sun within the temple, were also built to this orientation.

There was a trinity of gods in the Eighteenth Dynasty at Thebes—Amon-Ra; Mut, the wife of Amon-Ra; and Khonsu, the god associated with the moon; and all three are represented in the citadel at Karnak. South of the Amon-Ra temple, reached by an avenue of sphinxes, are the ruins of the temple complex of Mut. The main temple here was surrounded by a crescent-shaped sacred lake. There was a parallel temple to the west and a transverse temple to the north of the Mut temple. These three temples and other subsidiary chapels were built to a rectangular grid that, for reasons that will shortly become clear, was rotated by an angle of eight degrees to the grid of Amon-Ra. While the founding dates of the various temples have not been established with certainty, they were built over a 250-year period from



The High Room of the Sun, a small roof temple in the complex at Karnak, was open to the sky. It was dedicated to the sun-god on the horizon, and priest-astronomers, looking through an aperture in the southeast wall, could observe the sunrise at the winter solstice. A hieroglyphic name for the room, aha, *means "place of combat," where the sun overcomes the powers of darkness each year.*

the eighteenth to the twentieth dynasties.

What is of interest is that the temples were built to a grid, and that one of these was dedicated to "Khonsu the child," the moon-child. The main temple of Khonsu is situated within the mud-brick boundary walls of the Amon-Ra complex. At a casual glance it appears to be aligned with the latter grid, but exact measurements show a rotation of 1.9 degrees. Subsidiary chapels and a roof temple over the southeastern wall of the main temple follow this constructional grid. Within the main temple the pharaoh is depicted making offerings to Khonsu, and the god is shown in a form that an astronomer would presume to be the phenomenon of the "old moon in the new moon's arms." When the first thin crescent of the new moon is seen a few minutes after sunset, the faint disk, illuminated by reflected earth light, is seen within the crescent.

Since dynastic Egypt was a literate, historic society, one expects a clear, written account of what was being done and thought. This is available to some extent, particularly with regard to the calendar and time reckoning, but there is a vast area of activity—religion, death, and myths—that is obtuse or possibly deliberately secretive. It is possible that further understanding of ancient thought processes could be obtained through astronomy. Stonehenge, Maya temples in Yucatan, and other ancient structures appear to have been built to point to critical risings and settings of the sun and moon. To determine whether this is the case with the Egyptian monuments, we made the computer travel backward in time to test their alignment with the sun and moon for specific dates in Egyptian history. The slow variations of obliquity (tilt of the earth's axis), precession (conical motion of that axis), and regression of the lunar nodes (the two points in the orbit where the moon crosses the ecliptic) are sufficiently well known for calculations to be made for specific dates for several millennia in Egyptian history and prehistory.

Calculations show that in the period of the Eighteenth Dynasty, the axis of the Amon-Ra temple would have pointed precisely to the sunrise, disk tangent on the horizon, at the midwinter solstice. The Mut grid, as defined by the axis of the temple of Khonsu the child, pointed to the setting of the summer new moon, the first crescent after the solstice. The setting point was at the edge of the Theban Hills, near the Tombs of the Queens. At this point the crescent had its lowest southerly position in its 18.6-year cycle. Thereafter it moved to the left, taking up its most northerly position, over the Valley of the Kings. At the northerly extreme it was coupled to the grid lines of the main Khonsu temple.

Were these alignments intentional on the part of the builders, and do they contribute to the interpretation of the ancient thought system? The last word in the debate has not yet appeared in the journals, but there are several arguments in favor of such a view.

Many of the inscriptions in the Great Temple of Amon-Ra and in the tombs of priests and officials stress the worship of the sun-god at sunrise. In his translations, French Egyptologist Paul Barguet suggests that the temple as a whole had some unique cosmic significance and that it was designed to face eastward, away from the Nile. There is a small temple, the High Room of the Sun, in the northeast corner of the Hall of Festivals. Dedicated to Ra-Hor-Akhty, the sun-god of the two horizons (in conventional readings of hieroglyphs, a *y* at the end of a feminine word indicates a double plural; thus, two horizons), the temple was open to the sky. In its southeast wall are remains of an aperture through which the priest-astronomers could see the sunrise on the critical day of midwinter. This temple is an elevated structure and is placed directly over a wall inscribed with details of the foundation ceremony. These show the pharaoh staking out the cord, hoeing the line, and making and laying the bricks, but as I.E.S. Edwards has pointed out, the pharaoh's involvement was probably symbolic, with the exact work being done ahead of time by a survey team. If, as it seems, the line was laid to point to the sun tangent on the horizon, then the accuracy was within the limits of precision set by the resolving power of the human eye.

Furthermore, a critical sunrise, that of the winter solstice, was chosen. Another hieroglyphic name for this temple room, *aha,* translates literally as "place of combat." Astroarcheology supports this interpretation: the sun—at its lowest point in the ecliptic, its time of dying and rebirth—is overcoming its enemy, the winter solstice.

The roof temple on the terrace of Khonsu has two windows: one pointing outward to the southeast, the other inward over the expanse of roof toward the hills of Thebes, beyond which lies the Valley of the Kings. The southeast window is inscribed with general statements about the sun's passage across the sky. The high, northwest window is inscribed: "Live the good god, beloved of Amon [text damaged] who shines on the *benben*[et]*y* like the horizon house of [Ra?]." The word *benben* is conventionally translated as the "tip of the obelisk," or the "pyramidion"; yet in several inscriptions the whole temple is called a *benenet.* The inscription could refer to the good god, the moon-god, beloved of Amon, illuminating the temple by shining through the window slot. Alternatively *benben*[et]*y* could be the farthest points of the moon on the horizon. In the entrance gateway, built during a later period, the crescent moon is depicted on top of a pedestal. At the latitude of Thebes the crescent appears horizontal, exactly as depicted.

The second extremum of the crescent summer moon, the lowest southerly point in the 18.6-year nodal cycle, is marked by the grid of the Mut complex, particularly by the axis of the subsidiary temple of Khonsu the child. Again it seems unlikely that the grid of this third god of the Theban triad would align to an astronomical point by chance. Nor could the priest have failed to notice the alignment; the crescent moon was observed diligently because its disappearance before dawn marked the beginning of the Egyptian lunar month. The moon would move from the Khonsu the child axis to the roof alignment in the main Khonsu temple during a period of 9.3 years. And 9.3 years later it was back at the Mut position, thus completing the 18.6-year cycle. Interestingly, Khonsu is also known as the "wanderer." Perhaps Mut, as the wife of the sun, gave birth to the summer crescent at the point where it turned.

But what of the other ancient Egyptian structures? Does astroarcheology help us to understand their meaning? The base of the Great Pyramid was aligned as accurately as the human eye would permit to the geographic grid. The other Gizeh pyramids and the Sphinx also point due east, and it is reasonable to assume that these structures were aligned, not just to the sunrise, but to a particular sunrise, that of the equinox. The pyramids, the Sphinx, and the Theban temples give evidence for a joining of the earth and the sky, an ontological involvement with the cosmos. Similar evidence is found in other ancient cultures. It would seem that the first steps toward civilization came when a culture looked to the heavens.

The temple of Abu Simbel, approximately a hundred miles south of Karnak, has also puzzled scholars; and its meaning, too, might be clarified by looking at it from an astronomical point of view. Cut into a solid sandstone cliff, this temple is the largest monolithic sculpture in the world; its facade is covered with gargantuan effigies of Ramses II. Statuettes of the crowned hawk, symbol of the sun-god, line the terrace. Ra-Hor-Akhty stands over the door, and a frieze of baboons, greeting the dawn, surmounts the structure. Baboons, which make noises and "feel the warmth of the sun" before first light, were associated in the ancient mind with the sun.

The brilliant Nubian sunrise appears from out of the jagged cliffs across the Nile and the light glides down the rose-colored massif, penetrating the 180-yard length of the temple to the inner sanctuary. There it illuminates a statue of Ramses II, with Amon and Ptah on his right and Ra-Hor-Akhty on his left. This play of light, which takes place on only two days in the year—in early spring and late fall—seems to be significant, but no rationale is given in the inscriptions.

Ten years ago, the whole temple was cut into blocks and reassembled as a man-made cliff above the rising waters of Lake Nasser. Behind the enormous massif is a carefully concealed air-conditioning plant, which, by maintaining the interior of the temple at the same temperature and humidity that existed at the original level of the Nile, prevents deterioration of the sandstone, the carved reliefs, and the hieroglyphs. In the process of relocation the alignment was preserved.

A small side chapel, constructed of blocks with two miniature pylons at the front, was also disassembled and re-erected at the new site. Again, the alignment with regard to the facade was maintained. This chapel was dedicated to the sun-god of the two horizons, Ra-Hor-Akhty, and originally contained other symbols of the sun—four baboon statues, obelisks, and a scarab beetle. The walls still show the original carved reliefs of the bark of the sun, the boat in which the sun-god was thought to make its daily journey across the sky. From a small altar reached by steps, one can look out between the pylons.

This side chapel was almost certainly an observatory. There were other religious uses as well, but the directional line from the altar out through the gap in the pylons pointed to the extreme southerly sunrise at midwinter in the second millennium B.C. Since it is not as large as the temple of Amon-Ra, it cannot be as accurate, but within limits of the small irregularities in the structure and allowing for the different latitude, it couples with the same sky phenomenon as Amon-Ra and the Colossi of Memnon.

Ramses II was a great ruler. During his 67-year reign, he built more monuments than any other pharaoh, single-handedly fought 2,500 of the enemy at the battle of Kadesh, signed and upheld the oldest

Lit by the morning sun,
67-foot statues of Ramses II
cover the facade of the
Abu Simbel temple.
Members of the royal family
stand at his feet.

RENE BURRI, MAGNUM

existing peace treaty, was father to 111 princes, and had an undetermined number of wives. But he recognized his wife Queen Nefertari above all women, making her immortal with him by commanding the construction of a second rock-hewn temple next to his.

Does astronomy give any clue as to the reason for the Abu Simbel temple? Measurement of the axis gives two dates for the penetration of the sun's rays into the inner sanctuary—February 22 and October 18. Because the elevation of the distant skyline cannot now be measured from the original river level, there is an uncertainty of a day or so either way. Before the temple was moved, various observers placed the date of illumination between October 20 and 23 by the present Gregorian calendar. Louis A. Christophe has suggested that the date corresponds to I Peret I of the Egyptian civil calendar at the year of Ramses' first Jubilee. Scholars believe that the February date, produced as the sun retraces its path, has no significance.

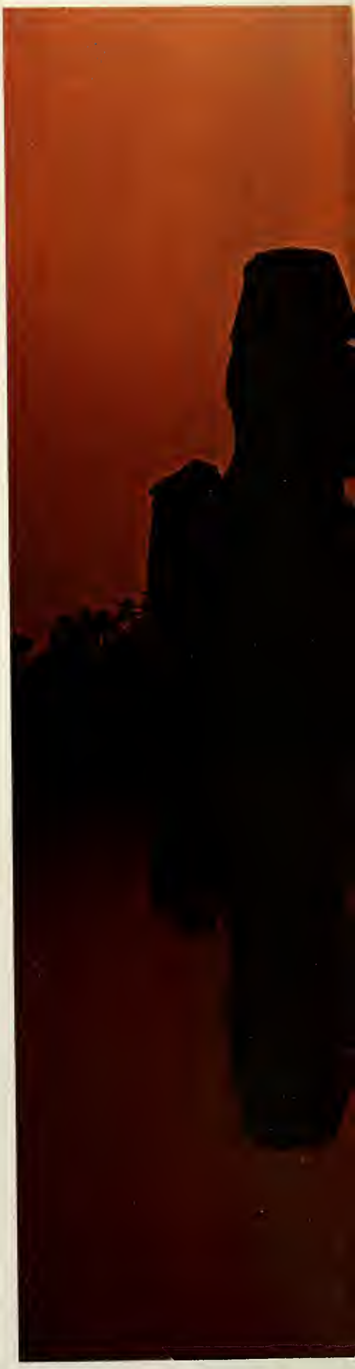
The Egyptian calendar, length 365 days, slipped with the seasons, and so the above figures delineate a narrow interval from about 1268 to 1248 B.C. when the sun's rays would penetrate the inner sanctuary at the Jubilee date of I Peret I. Among the estimates of the beginning of Ramses' reign are some that would place the Jubilee within the above period.

This simple result, if accepted, would radically alter the interpretation of the temple. Was the site carefully selected and astronomically planned so that after years of construction, the flash of sunlight would strike the pharaoh-god effigies on Jubilee day, bringing life and rebirth to Ramses and starting a process of deification? The few seconds of this celestial ceremony would be reenacted each succeeding year, although the date would fall progressively later in the civil calendar.

It is a tempting conclusion, yet there is no explicit mention of this idea in the hieroglyphs. On the positive side of the argument, one has the evidence of awareness of earth-sky lines in the temples of the three main gods at Karnak and in the alignment of the pyramids, Sphinx, and Colossi. Also the small adjunct chapel at Abu Simbel, out of keeping with the broad sweep of the architecture, seems to have been intended to mark the turning point of the sun on December 23—the day of the year when it rose farthest to the south. Egyptologists have suggested, on the basis of internal evidence, that Ramses II became equal to the gods during his lifetime in a manner that transcended previous pharaohs, with the change beginning during his thirtieth year.

As with other ancient cultures, it is difficult for the modern mind to bridge the gulf of time and space. Over a span of three millennia in Egypt many highly intelligent people thought, figured, and solved. The feeling today is that there was an underlying principle in Egyptian philosophy that has not yet been fully understood. Beyond the inconsistencies in their myths and legends, there seems to have been a basic set of ideas that helped to produce an enduring civilization. At least part of those ideas might have been an appreciation of order and stability in the greater environment, in the cosmos, and in the reliable movement of the heavenly bodies. In the words of the priest Kherouef:

> The doors of the underworld open, O Sokar, Sun in the sky, O reborn one! This is Atum who gets up, when you are seen brilliant on the horizon. You give back to Egypt her beauty, each time the sky is pierced with rays, each time you are born as a disk in the sky. ☐



The Colossi of Memnon face east across the Nile Valley. Until the northern figure, right, was repaired in the second century A.D., *it was known as the "talking statue," because it emitted a loud, crying sound at dawn.*

BRIAN BRAKE, RAPHO GUILLUMETTE

by Raymond Sokolov

Some Like It Hot

But some like it cold, and some may even like it in a pot nine days old

During World War II, my father was stationed for a time in El Paso, Texas, near the Mexican border. Although he brought away little else of value from this stint at Fort Bliss, he did return to Detroit with a taste for fiery jalapeño peppers. For me, those pale green tongue burners, lurking in ambush among the cocktail snacks, were a test of manhood. But when I managed, at thirteen or so, to gulp one whole without a tear or a yelp, I discovered that I had been initiated into a tribe that numbered, as of that day, only two. No one else I knew could endure even the most exploratory lick. I was forever doomed to be a hot person in a cold culture.

Now I do not presume to assert that modern America is a cold society in the normal sense. Personal warmth abounds. There can be no doubt, however, that as a nation we belong on the cold side of one of the world's few cultural dichotomies: the great hot pepper divide.

While millions of other peoples don't think a meal is a meal without hot peppers, we lack even a native and unambiguous term in our language for cayenne or chili or the dozens of other species of the genus *Capsicum.* We lump them together with the far milder and botanically unrelated black (and green and brown and white) peppercorns as, simply, peppers. French, at least, distinguishes between *poivre* and *piment.* But English passes over this crucial sensory difference with benign neglect and confuses the issue further by referring to all dishes, either high in temperature or high in seasoning, as "hot" food.

There are historical reasons that help somewhat to explain why normal American food is not seasoned like the comparatively pyromaniacal fare of Ethiopia, Indonesia, Thailand, India, China's Szechuan province, most of West Africa, Mexico, and a good part of the rest of the tropics and subtropics. Hot pepper is not native to Europe and was a late arrival. Even the black peppercorn (*Piper nigrum*) was rare and costly in northern Europe well into the modern period. The Dutch garrisoned pepper-growing islands in the Indian Ocean to protect their precious plants. And the aptly named Pierre Poivre earned glory for himself by initiating the growth of pepper in the French empire of the eighteenth century.

Black pepper by now is an established item on every table, although folk wisdom still warns English-speaking children that an excess will cause sneezing. And, given the cheapness of the spice today, it seems quaint to read that no less a firebrand than Martin Luther once fulminated against the pepper trade as the "big boat carrying off Germany's money."

The capsicum peppers (with the exception of mild paprika) did not find a warm welcome in Europe. Columbus discovered them growing on the Caribbean littoral. But the timorous Western palate was never able to tolerate more than a mere suggestion of the leading commercial form, cayenne, as a staccato accent in, say, sauce diable.

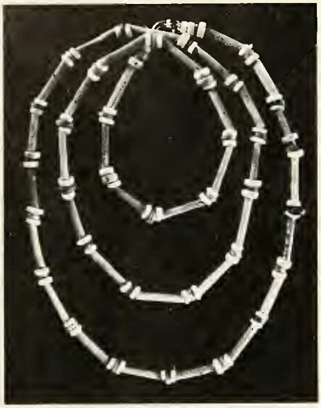
In the United States, one can point to the use of Tabasco in Bloody Marys and cocktail sauce. Texas chili has its adherents. Ginger ale gets its pungency from *Capsicum.* And there is currently a vogue in a few big American cities for the chilified cuisine of Szechuan.

Still, the American palate, even when it indulges in hot foods, reacts to them with a shudder. Weaned on a cold cuisine, we have no background in hot tastes and are so struck by the intensity of the experience that we have trouble sorting out the different strains of flavor that can be supplied by the multifarious hot seasonings mixed up in a well-prepared hot dish. We also tend to look down on hot cuisines

STEVE MYERS

Gen ine Artifacts and Antiquities Unusual Gifts from Ancient Worlds

aladdin house, ltd.
648 Ninth Avenue • New York 10036 Dept.-474



NECKLACE OF 2000 YEAR OLD EGYPTIAN BEADS

This fine necklace (24" long) features select quality tubular & disc beads from Ancient Egypt. These glazed faience beads of vibrant blue, subtle green & buff with an occasional sprinkling of muted red & ochre, all combine to form a glorious rainbow of ancient color.

N–	Necklace of Ancient Egyptian beads	$29.50
*EP–	Matching bead earrings (S.S. Pierced)	10.50
SET–	Necklace with pierced earrings	37.50

* Sterling Silver screwbacks add $3.00.

★ Necklace makes a great "Historic Gift".
★ Stimulates thought provoking conversation.
★ Compliments both formal and casual attire.
★ Jewelry boxed with attribution certificate.

IMPORTANT! Limited collection of necklaces—send order at earliest convenience.

- New York State residence add sales tax.
- Insured postage $1.50. Airmail add $1.
- Two week money back guarantee.
- Gallery open by appointment, phone CI 6-0793.
- BANKAMERICARD or M.C. may be used for minimum orders totaling $50. or more.

COLLECTOR'S CATALOG — 24 pages picturing over 75 Ancient World Relics from BC to AD. Plus, catalog featuring over 50 ancient jewelry replicas in sterling silver, 14 Karat and 18K. Gold. Both catalogs — 50¢. FREE WITH ORDER. *MUSEUM INQUIRIES WELCOME*

SPECIAL NECKLACE (24") ALL 18TH DYNASTY RICH BLUE FAIENCE TUBULAR BEADS $75, EARRINGS $25. NECKLACE AND EARRING SET $95. ORDER TODAY.

ALADDIN HOUSE, LTD. Dept. N-474
648 Ninth Avenue • New York 10036
Gentlemen: Enclosed is my order for:

CHECK ______ (Includes S.T. & Post.)
☐ BANKAMERICARD ☐ M.C. 4 digits ☐☐☐☐
CHARGE NUMBER ______
EXPIRATION DATE ______
CHARGE SIGNATURE ______
☐ Enclosed 50¢ for catalogs — FREE WITH ORDER
NAME ______
ADDRESS ______
CITY STATE ZIP

because they have so often originated in nonindustrial or nonwhite cultures.

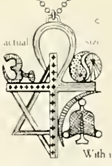
Otherwise discriminating eaters will look up from a plate of the Mexican national dish, turkey en mole poblano, with its mixture of three quite distinct-tasting chilies and dismiss the entire achievement because it "anesthetizes the tongue." *It* (meaning any number of highly individual hot peppers) is supposed to be used to "disguise bad meat" or "take people's minds off their poverty." One also frequently runs into the culture-bound view that all hot food is just crude stuff, an assault on the body that no civilized cuisine would permit.

This is nonsense. For one thing, the so-called advanced nations have no monopoly on bland food. Anthropologist Audrey Richards notes that the Bamba of northern Rhodesia rarely eat highly seasoned food, although dried peppers are available to them. The Nambikwara of Brazil use no spices or peppers at all and dilute their food with water to cool and attenuate its taste.

On the other hand, from the hot side of the ethnic pepper barrier, the bland cuisines taste like baby food. Miguel Covarrubias, the Mexican artist, wrote from Bali in 1937: "Most Europeans used to beef and boiled potatoes, simply cannot eat Balinese food, but on the other hand no Balinese of the average class can be induced even to touch European food which is *nyam nyam*, that is, 'flat and tasteless.' "

For his part, Claude Lévi-Strauss has concluded in his analysis of the myths of preliterate America that the hot pepper is the symbol of civilized eating among the indigenous peoples of our entire hemisphere: "It is striking, indeed, that the majority of American societies view rotted food as the prototype of precultural nourishment and consider the hot pepper, which is their principal condiment, as the element that separates nature and culture."

Accordingly, in Martinique, the Carib-West African palate transformed the relatively bland blood sausage of France into a more "civilized" *boudin créole* through the addition of the small, globular capsicums typical of that island. Many other accommodations between hot and cold cultures have occurred. Simone Beck, Julia Child's Gallic collaborator on *Mastering the Art*



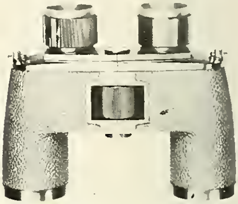
oneness

A subtle linking of man's religious symbols, delicately wedded together by the artisan.

With illustrated descriptive booklet

14K with 24" chain	$37.50
Sterling Silver	$16.75

ISAAC SOLTES DESIGN NH
1923 S. McPherrin Ave.
Monterey Park, Calif. 91754
Check or Money Order / Money-back Guarantee



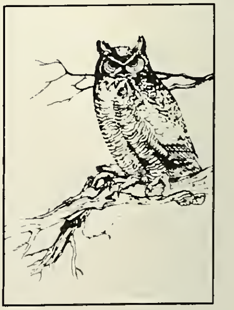
BUSHNELL 7x35 CUSTOM

Mfg. List $139.50 Postpaid $84.50

This is an example of the deep discount prices on high quality optics that is found in our FREE catalog. This catalog lists and illustrates an outstanding selection of camera lens, telephoto lens, telescopes, binoculars etc., plus valuable information on how to properly select them. Write for it today.

GIL HEBARD OPTICS
COURTHOUSE SQ., KNOXVILLE, ILL. 61448

free wildlife prints



Join 60,000 League members who are creating a better environment. Membership entitles you to a free 10 x 13 inch limited edition wildlife print signed by artist-naturalist Charles J. Johnston, plus a year's subscription to *Outdoor America*.

Send $10 annual membership fee and selection of ruffed grouse or great horned owl numbered print to The Izaak Walton League of America, 1800 N. Kent St., Suite 806, Arlington, Va. 22209.

from the Izaak Walton League

CROWDER NATURE TOURS

. . . resuming after a lapse. The original overseas Nature Tours; started in 1961 several years before the first others joined the field. Still have an amazing world coverage. Do you have our famous "Tour Book"?

Emphasis principally birds, under expert leadership, but non-birders also find our offbeat routes of extraordinary interest. A non-profit operation.

PROGRAM FOR 1974
(No. Am. trips 2 wks.; all others 3 weeks)

[1]Sub-Tropical America: April-May
[2]Europe: June-July (5 tours)
Africa: East Africa June 29; Madagascar July 20
[3]South Pacific: July-October (7 tours)
Himalayas: Sept. 7 (Nepal-Bhutan-Brahamaputra Valley)
South America: September (Colombia; Venezuela-Guianas)

[1]Sub-Tropical America series now firming up: Texas-Northern Mexico April 20; California May 4; Arizona May 25.
[2]Europe: Scottish Islands June 6; Mediterranean June 6; Norway June 29; Middle East June 29, USSR (six weeks, all 15 Soviet Republics, plus Outer Mongolia and around the world) July 20.
[3]South Pacific: Very heavy coverage; if at all interested, do write.

1975 Tours Schedule Now Available on Request.

CROWDER NATURE TOURS
NOTE: Unannounced tours often run; what is your interest?
Box 222-a
Harpers Ferry, W. Va. 25425

Historical mysteries solved

BEYOND STONEHENGE

by Gerald S. Hawkins
author of *Stonehenge Decoded.* A scientist's fascinating astro-archeological account of Stonehenge, the Peruvian desert drawings, the Egyptian temples, and other strange phenomena. "Absorbing."—*Book-of-the-Month Club News* 3rd Printing $10.00

Harper & Row
10 E. 53rd St., New York 10022
1817

of French Cooking, told me that it was from Mrs. Child that her palate learned to appreciate the slightly higher level of seasoning prevalent in America. Is the famous "delicacy" of French food partly due to the cultural caution of French cooks with salt?

In any case, it is tempting to imagine how a pimentophile savage would go about civilizing American food. Having been taken by his native Californian informant for a typical meal at a drive-in, he might very likely retaliate as follows:

Hamburger Sauvage

2 medium onions, chopped
2 tablespoons oil
½ teaspoon salt
½ teaspoon black pepper
12 dried red chilies, crumbled (see note)
2 teaspoons ground cumin
1 pound ground beef

1. Sauté onions in oil until transparent.
2. Add salt, pepper, chilies, and cumin. Stir briefly and be careful not to burn chilies.
3. Add ground beef. Sauté over medium-high heat, breaking up the meat so that it combines smoothly with the other ingredients and so that all particles brown individually. Prepared in this way, the beef will obviously not emerge as a hamburger patty. If you insist on patties, do the first two steps, mix the chili mixture in with the meat, off heat, and form the resultant mixture into four patties, which can then be cooked like conventional hamburgers. A warning: if you refrigerate these patties overnight, they will be even hotter, because the influence of the chili increases with time.

Yield: Four servings.

Note: Chilies must be approached carefully. Do not touch your eyes after handling them or you will be very sorry. Chinese, Indian, and most other third-world markets sell dried chilies. Commercial crushed red pepper is only a passable substitute (2 tablespoons' worth will make a rough equivalent for this recipe). You can mail-order dried red chilies from Wing Fat, 35 Mott Street, New York, N.Y. 10013. They will keep almost indefinitely in a glass jar, unrefrigerated. ☐

Share the Thrills of Exploring Outer Space!

$219.95
f.o.b. Hartford, Conn.
$15 Crating Charge

All DYNASCOPES, including this superb RV-6, 6-inch available on easy terms!

Now it's easy to join the thousands of serious amateurs who have discovered the excitement of exploring our mysterious universe. Your enjoyment begins right from the start, yet the challenges and rewards go on for years! And it's a hobby that can be shared at modest cost.

Choose From Many DYNASCOPES®

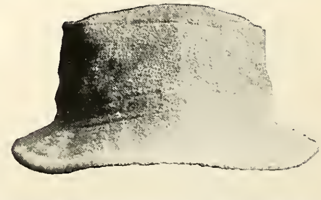
Picking a telescope to fit your needs and your pocketbook is simple when you select a DYNASCOPE—the same instruments used by more than 150 schools, colleges and observatories—and your satisfaction is guaranteed by a full-refund warranty.

FASCINATING GUIDE YOURS FREE!
Read these valuable facts before buying any telescope. Mail coupon or postcard for your complimentary copy of this helpful guide.
Criterion Manufacturing Co.
331 Church St., Hartford, Conn. 06101
® TM Registered U.S. Pat. Office

Dynascopes

CRITERION MANUFACTURING CO., Dept. NH-47
331 Church St., Hartford, Conn. 06101
Please send your free Telescope Guide.
Name________
Address________
City________ State________

Talented Little Towel



Absorbent terry cloth towel is shaped into the Eddie Bauer Toweling Hat to outsmart summer heat two ways! When your brow is perspiring, just wipe it with your hat. Or douse your hat in water, wring it out and wear it to keep your cool at tennis, boating, fishing, camping or golf. Sizes: S(6¾-6⅞), M(7-7⅛), L(7¼-7⅜), XL(7½-7⅝). Colors: White, Yellow, Powder Blue, Navy. 2002 Toweling Hat, $4.95 postpaid.

Order today! Money-back guarantee!
Enclosed is my check or money order for $______. (Add sales tax where applicable.)
Please rush my 2002 Toweling Hat.
Size________ Color________
Name________
Address________
City________
State________ Zip________
☐ Send me FREE your color catalog of over 1000 exciting outdoor products.

Eddie Bauer
Dept. HNH, 1737 Airport Way S., Seattle, Wa. 98124

Presenting The Invisible University

Once upon a time, we used to try to stuff all of our learning experiences into neat little boxes.

The spatial boxes were classrooms and the time boxes were labeled Grade School, Junior High, High School, and College.

But now we're breaking out of the boxes (perhaps because we felt we were suffocating) and finding new learning adventures all around us, all our lives.

Television documentaries, book clubs, paperbacks, magazines, 16mm films and cinema verité, correspondence courses, talking tape cassettes, museums going show business—all are part of an "invisible university" that permits any interested citizen to share in the joy of discovery with today's scientists and thinkers.

We're finding out that you don't have to have a college degree to be an educated person—and that you don't have to stop educating yourself after you get one.

This may explain the phenomenal growth of the fairly new monthly magazine Psychology Today. In just five years, it has zoomed up out of nowhere to a circulation well over 850,000 monthly copies.

Psychology Today was introduced to bridge the gap between the laboratory and the living room, the professional and the educated layman.

Each month it presents the views and findings of pioneering professional researchers and thinkers, including leaders like Carl Rogers, Bruno Bettelheim, Margaret Mead, Erich Fromm, Harvey Cox, John Lilly, B. F. Skinner, Kenneth Keniston, Herbert Marcuse.

Not jazzed up. Not watered down. Not clouded over with professional jargon. Just straight and clear in a way that both professionals and an interested general audience can enjoy and appreciate. And visually enhanced with colorful prize-winning avant garde graphics that reinforce the tingling feeling of high adventure.

Traditionally, in many college subjects, you had to grind for a year or two through agonizingly dull basics before you got to "the good parts." In Psychology Today you start out with "the good parts"—the fascinating, illuminating contemporary discoveries about who we are, why we act as we do, and how we can change.

Here are a few topics under recent discussion in our section of "the invisible university" . . .

Does sports activity really build character?

Can a psychological test predict your success in business? In investing?

Why do fat people eat even when they're not hungry?

How might psychology have prevented the Vietnam war?

Why do many bright, capable women in business have a will to fail?

Can three people be happily married —to each other?

Does "the screaming" cure really work?

How can income tax forms be made foolproof?

Can a chimpanzee learn to read and write?

Can criminals be rehabilitated through brainwashing? (And *should* they?)

Can fingers see color?

Why do we expect beautiful people to be smarter?

Should we teach children to read the way pigeons are taught to play ping pong?

Is there really such a thing as hypnosis?

Some of it is daring theory. Some is outrageous opinion. But much is startling fact and measured experiments which will rob you of some of your fondest pet notions—and provide you with powerful ammunition for your next argument with friends.

Should you be "enrolled"? It costs you nothing to find out. Just mail the coupon. We'll send you a copy to read free and enter your name as a trial subscriber at the special introductory rate for new subscribers indicated on the coupon. However, if you're not delighted with the first issue, simply write "cancel" on the bill and return it without paying or owing anything, keeping the first issue with our compliments.

COMING OF AGE AT COLLEGE
Emotions and Muscle Tension
psychology today
psychology today

BUILD YOUR OWN PERSONAL LIBRARY ON THE HUMAN SCIENCES

The lasting value and significance of the articles in Psychology Today make each issue a valuable addition to your home library of literature on the human sciences. To assist you in building this library, we periodically offer at moderate cost these handsome black slipcases for holding your back issues. Sturdily constructed and stamped in silver ink on the spine, each case holds 12 issues of Psychology Today.

Mail coupon below for Half-Price Offer to New Subscribers

8227

psychology today

P. O. Box 2990, Boulder, Colorado 80302

Please send me, without cost, obligation or commitment, my complimentary copy of the current issue. If I like it, bill me for a year's subscription (11 additional issues for a total of 12 issues in all) at just $6 instead of $12, half the regular price. If I don't like it I will write "cancel" across your bill, return it, and that will end the matter. In either case, the complimentary issue is mine to keep.

Name ________________ PLEASE PRINT

Address ________________

City ________________

State ________ Zip ________

Subscriptions outside the U. S. and Canada $2.00 higher.

I want to give Natural History as a Gift

Enter my gift (a one-year Associate Membership in The American Museum of Natural History and 10 issues of Natural History magazine) for the people listed below. **Bill me later at $8 for each gift.**

SEND GIFT TO: ☐ NEW ☐ RENEWAL

NAME

ADDRESS

CITY STATE ZIP

SIGN GIFT CARD FROM:

SEND GIFT TO: ☐ NEW ☐ RENEWAL

NAME

ADDRESS

CITY STATE ZIP

SIGN GIFT CARD FROM:

MY NAME

ADDRESS

CITY STATE ZIP

And That's Not All

With their membership and subscription, my friends will also receive two bonus books (special members' editions); free admission to the Museum; use of the Members' Reception Lounge and a discount in the Museum Shop.

NATURAL HISTORY

Outside U.S.A., please add $2.00 per year for postage. J121

FIRST CLASS
PERMIT NO. 4946
DES MOINES, IOWA

BUSINESS REPLY MAIL

No Postage Stamp Necessary if Mailed in the United States

POSTAGE WILL BE PAID BY—

NATURAL HISTORY
P. O. Box 5000
Des Moines, Iowa 50306

Atmospheric Titan

The planets are obvious, brilliant beacons in our night sky. Venus, Mars, Jupiter, and Saturn usually are among the brightest points of light in the heavens, and this prominence has led astronomers to devote much time to them. In fact, many astronomy texts tend to leave the student with the impression that the sun and planets make up all of our solar system.

There are, however, other, just as interesting objects in the solar system: the moons. Because our own satellite is obviously barren and lifeless, the possibility of life on any satellite in the solar system has typically been dismissed with little thought. But some astronomers are coming to believe that this dismissal is hasty, and we are gradually learning that these other moons are definitely not carbon copies of our own.

The thirty-two natural satellites in the solar system range from large bodies, comparable in size and mass to Mercury, to others that would not even be visible from the surface of their primary planet. Some follow circular orbits in the same planes as the equators of their planets, while others describe eccentric ellipses inclined at steep angles to the equatorial plane. Although there are more moons than planets, little is known about them. They are smaller than planets, harder to see, and at first glance seem unlikely places to study the early chemical processes that lead to life. Yet conditions on one of these moons, Titan, may be reminiscent of those of the early earth.

A small, inconspicuous body in the solar system, Titan, Saturn's largest satellite, is the only moon known to have a dense atmosphere. In 1944 the late Gerard P. Kuiper of the University of Arizona found that two frequencies in the sunlight reflected by Titan are efficiently absorbed by methane gas. For the next quarter of a century this was nearly all that was known about Titan's atmosphere. In the last few years, however, attention has focused on this distant satellite, which has twice the volume of our moon and about half the mass of the planet Mercury.

Because Saturn's distance from the sun is more than nine times as far as earth's, one would expect Titan to be cold, about -200° C. But detailed study of Titan's infrared emissions shows it to be much warmer—at least -128° C. Even more surprisingly, we now have a measurement of Titan's surface pressure—a startling 0.4 earth atmosphere. Thus, a satellite with only 1.9 times our moon's mass has a surface pressure hundreds of times greater than that on the surface of Mars.

An important key to the mystery of Titan may be its distance from the sun, much farther than that of our own moon, and we can expect the warming influence of sunlight to have played a different role in the evolution of any possible atmosphere.

Near the top of an atmosphere a high-velocity molecule moving directly upward has a good chance of escaping. For a given temperature, the lightest molecules escape most readily. Thus, hydrogen, helium, carbon dioxide, and other relatively light gases should rapidly diffuse away from less massive objects, such as Titan. Heavier gases, such as methane, nitrogen, and ammonia, may cling to large moons, however, and provide a fairly thick atmosphere. What matters is the temperature at the top of the atmosphere, which is determined primarily by the amount of sunlight falling upon it. The temperature of the lower atmosphere may be considerably different, a fact with important implications.

How can we account for Titan's warmth? The only reasonable explanation seems to be that a greenhouse effect operates there, trapping the sun's heat. This process begins when visible light passes through the atmosphere and warms the surface. Once heated, the surface radiates infrared waves outward. Although the atmosphere is transparent to sunlight, infrared light waves will be absorbed, and heat will be retained inside the atmosphere.

Since 1944 Kuiper and others have closely studied Titan. They observed that it has dark and light markings, which change with time. Cornell University's Joseph Ververka has noted that sunlight reflected from Titan is reminiscent of the reflection from clouds, rather than from a solid surface. Titan is also red, a property not fully understood. Until recently these facts fit together into a fairly consistent view. Although Titan has only one-sixth the earth's gravity, the top of its atmosphere is relatively cold, so it should retain heavy gases such as the methane Kuiper found, but not lighter gases. Thus, astrophysicists were surprised when Lawrence Trafton of the University of Texas announced in 1972 that he had found hydrogen, the lightest gas of all, in Titan's atmosphere.

Hydrogen, like methane, efficiently absorbs infrared radiation and seems a good candidate for a greenhouse agent. The presence of hydrogen in Titan's atmosphere is a mystery, however, unless it is steadily replenished by the moon itself. Cornell University's G. Mullen and Carl Sagan believe volcanoes on Titan may give off large quantities of liquid ammonia, methane, and water. These fluids could percolate to the surface, evaporate, and enter the atmosphere. Ultraviolet sunlight would then break them down into hydrogen and several types of organic compounds. This would be a continuing source of hydrogen, and the organic molecules could explain Titan's reddish hue.

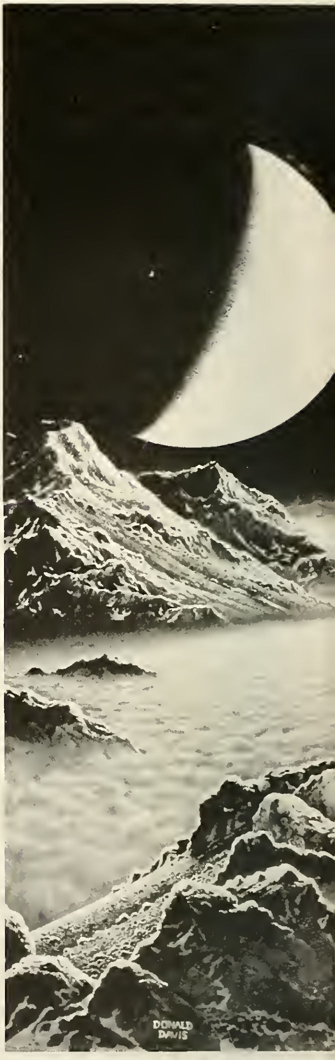
Thomas McDonough and Neil Brice of Cornell University have speculated that hydrogen may appear in Titan's atmosphere because, although it escapes, it must inevitably return. A hydrogen molecule that leaves the top of Titan's atmosphere goes into orbit around Saturn, but it does not have enough velocity to leave the vicinity of Saturn's deep gravitational "well." Thus, a doughnut-shaped ring of hydrogen would accumulate around Saturn in the region of Titan's orbit. Eventually, a wandering hydrogen molecule will encounter Titan again and, if conditions are right, be recaptured. This process could greatly increase Titan's hydrogen concentration. There are only calculations to support this theory, but it does raise the interesting possibility that Titan may be capable of "cycling" its atmosphere into outer space and back again.

Whatever the mechanism, methane and hydrogen combine to form a warming blanket around tiny Titan. Recent theoretical studies have tried to sketch the formation of such small worlds, assuming they began as large clumps of the dust and various ices that seem prevalent in the outer solar system. According to such studies, the heavier, rocky portions of the mix then sank inward and formed a core surrounded by a thick mantle of liquid water and ammonia. Gravitational compression probably warmed the interior somewhat, providing the heat to keep most of the water and ammonia slush from freezing. Overlying this is a crust of solid ice perhaps thirty miles thick. Meteorites falling on this crust would cause extensive cracks and spectacular craters. Volcanic magma boiling up through the liquid mantle would warm parts of the surface, perhaps providing pools of liquid methane.

There are probably no ponds of water or liquid ammonia, for although Titan is anomalously warm, it is still quite chilly by earthly standards (ammonia freezes at –78°C. on earth). In chemical composition our picture of Titan's surface resembles the early earth. It is a much colder place, however, and at first glance seems an unlikely site for important biological processes.

But our ideas about biochemistry are based on a narrow range of experience. In the early earth, there were probably many more avenues available for chemical evolution. We know that life without oxygen once held sway on our planet and has now virtually vanished—it lost out to those organisms that could use oxygen as a metabolic catalyst. There were probably other incipient living systems, based on the somewhat different biochemistry of that age, but the system we know now was highly successful, literally devouring its early competition. The winner in this early struggle among life systems was probably dictated by chance ingredients on earth at that time. As far as we know, there is no reason why our particular biochemistry is the only one that survives in a wide range of planetary environments.

All living creatures on earth are made up of complex carbon compounds containing nucleic acids and proteins. The nucleic acids carry the blueprint of inherited characteristics, and the proteins do the many tasks of transmitting this information. These ingredients live in a bath of water; all life we know has evolved to use water wherever possible. Life is essentially supported by a welter of complex organic molecules immersed in water. But water is not the only solvent that promotes chemical reaction. Many of ammonia's properties—heat capacity, heat of evaporation, versatility as a solvent, and tendency to liberate a hydrogen ion—are, in the biological sense, almost as good as water's.

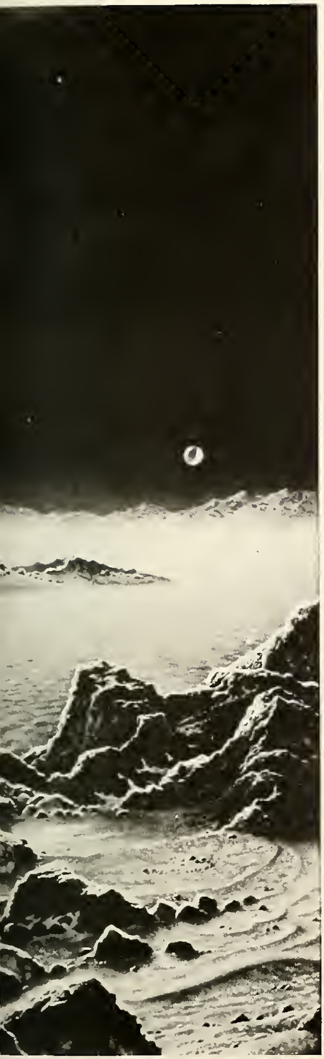


An artist's rendition of Ganymede, Jupiter's fourth and largest moon, shows the snowfields and rocky areas that may exist there. The large crescent is Jupiter itself.

DONALD DAVIS

If there were liquid ammonia on Titan, many biological reactions analogous to those that occur in water would be possible. But it is likely that conditions do not permit liquid ammonia, and that there are, instead, ponds of methane. Methane, however, is not the same sort of liquid as water. In water, molecules of ordinary salt break up into separate ions of sodium and chlorine. Water's ability as an ionizing solvent enables it to encourage chemical reactions and the formation of complex structures. But in a totally inert background, such as methane, substances receive no help from the solvent, for it cannot dissolve substances that have separated positive and negative charges in them. This would seem to destroy any analogy we wish to make between life in a water ocean and life in a methane pool. But methane can dissolve other types of substances, such as fats or oils. Water cannot do this—thus "oil and water don't mix."

Proteins are very long molecules capable of carrying a great deal of information in their complex chains. This variety and versatility seem necessary to communicate the vast library of genetic information that life requires. To imagine a methane environment that is not



hostile to the formation of complex structures we must search out long organic molecules that can interact in methane. Ammonia and water can break up materials and speed reaction because the electric charges in their molecules are not symmetrically distributed. These are called polar liquids, meaning they can dissolve substances, such as ordinary salt, that have separated charges in them. Methane, however, is a nonpolar liquid. There are already some nonpolar molecules on earth that could conceivably react in a methane environment. Our brains, in fact, contain giant nonpolar molecules of complex and unknown function.

The obvious drawback to liquid methane as a background for chemical evolution is its coldness. Life uses marginally stable compounds that can react quickly and variously in many subtle fashions. Temperature has a great influence on these reactions. At earthly temperatures the hydrogen bond produces arrangements that can be conveniently broken, yet at the same time they do not fall apart if left alone for a short while. In cold methane ponds weaker bonds might play the same role that hydrogen bonds do on earth. Our earthly biochemistry would be sluggish indeed in a methane ocean. But we cannot rule out the possibility that fat chains can be quite reactive in cold methane surroundings. These molecules would be so unstable at earthly temperatures that we probably do not even know of them.

There must, of course, be sources of energy to drive chemical reactions, in addition to a hospitable solvent to contain them. Although we know little of surface conditions on Titan, there are probably energy sources resembling those on the primitive earth. High-energy particles from the sun bombard the surface, lightning may fork between the methane clouds observed above Titan, and volcanoes could be a continuing source of heat and raw material percolating up from the moon's core.

Remembering that reactions at low temperatures require less energy to drive them, we can speculate that complex organic chemistries may proceed at respectable rates in methane ponds. Long molecules, such as the fats and oils we know, could combine in subtle fashion to set the stage for life itself.

What of other, larger moons in the solar system? According to earthbound observations and the results of Pioneer 10, two of Jupiter's moons, Io and Ganymede, also have atmospheres. But the gases clinging to their surfaces are a million times thinner than Titan's.

Io is an odd object. It circles close to Jupiter, and after it emerges from the planet's shadow, it is unusually bright. But the luster fades within fifteen minutes, leading some observers to speculate that Io's atmosphere condenses out in the cold shadow. Like Titan, Io is red.

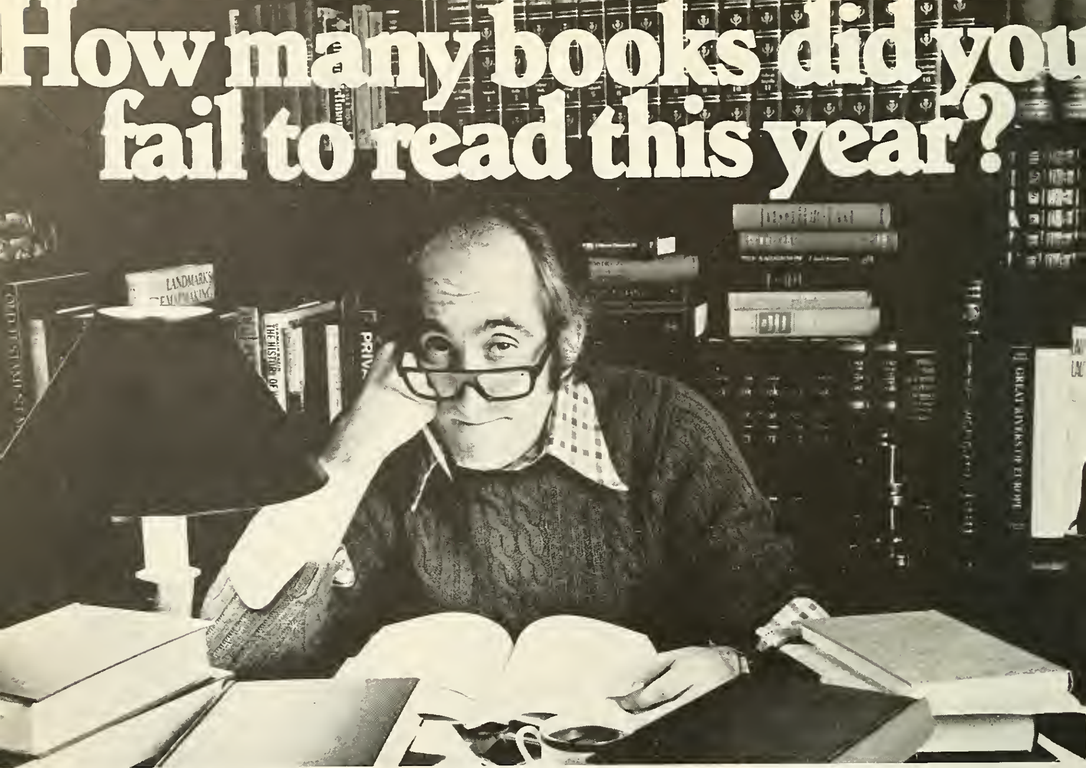
The largest satellite of all is Jupiter's fourth moon, Ganymede, which has 0.16 earth gravity. Because it is closer to the sun than Titan, the top of its atmosphere should be warmer; perhaps this is why it has not retained as much gas as Titan has. Like all four of the large Jovian moons, Ganymede reflects light well and shows light and dark patches. Since this reflected light seems characteristic of snow or rock powder, the moons may contain snowfields among areas of dirty ice or bare rock.

Our reasoning that ammonia or methane could be life-supporting solvents holds equally well when applied to the large Jovian planets—Jupiter, Saturn, Uranus, and Neptune—themselves. There is good evidence that a greenhouse effect operates within Jupiter. Some layers deep within these planets are probably at earthlike temperatures. Possibly ammonia and methane seas exist on them. Recent experiments have shown that complex organic structures form readily in conditions such as those on Jupiter.

Studying oceans deep inside the giant planets, however, will be extremely difficult. Clouds at the top of Jupiter's great atmosphere move faster than the velocity of sound; our space program cannot muster rugged probes capable of surviving entry far into the Jovian cloud belt. In terms of energy requirements and landing conditions, though, the moons of Jupiter and Saturn are comparatively easy to reach. If elementary biochemistries have evolved on these moons, we could investigate them at relatively small cost.

Within a decade we may have preliminary answers to questions of life on Mars and among the clouds of Venus. But to gain more knowledge about the prevalence of life in the universe, space exploration may turn to the moons of Jupiter and Saturn, particularly Titan. There we may find circumstances reminiscent of the early earth and solve many riddles otherwise impossible to explore, since present conditions on our planet are radically different from those that occurred before life began. Although we customarily think of the planets as possible hosts for life, it may be that we will finally learn more about the origins of life by studying a small, reddish moon—Titan. □

How many books did you fail to read this year?



There are several reasons why you didn't read all the books you intended to last year:

—You didn't have the time to get to all of them.

—You forgot to pick them up at the bookstore.

—You were ambivalent about a book—weren't quite sure what it was about, and whether you really wanted to read it.

—The waiting list at the library was too long.

—You can't afford to buy all the books you need to read.

—You missed the reviews—or there were none.

We have found the solution to all of the above problems.

It's called BOOK DIGEST. BOOK DIGEST is a new magazine which will be published every two months.

Each issue will contain carefully edited selections and condensations of from ten to twelve important books.

You will find four different kinds of books in BOOK DIGEST.

First, the smash best-seller.

Second, books that appear in BD at the same time as they begin to appear in bookstores and on best-seller lists.

Third, books that may never be best-sellers, but that are strong, important books you should be familiar with.

Fourth, forthcoming books, which will appear in BOOK DIGEST prior to publication elsewhere.

For example, our first two issues will contain the following books, among others:

- Imperial Presidency by Arthur M. Schlesinger, Jr.
- Real Lace by Stephen Birmingham.
- Cosell by Cosell.
- Economics and the Public Purpose by John Kenneth Galbraith.
- Pentimento by Lillian Hellman.
- Marilyn by Norman Mailer.
- The Making of the President by Theodore H. White.
- Kind and Usual Punishment by Jessica Mitford.
- The Anderson Papers by Jack Anderson.
- The Mind of Adolf Hitler by Dr. Walter Langer.
- The School Book by Postman & Weingartner.
- Why Johnny Can't Add by Morris Kline.
- The Feminist Papers by Alice S. Rossi.
- The L.A. Times Natural Foods Cook Book by Jeanne Voltz.
- Stalin as Revolutionary by Robert C. Tucker.
- The Secret Life of Plants by Peter Tompkins & Christopher Bird.
- A Strategy for Daily Living by Ari Kiev, M.D.
- How to Save Your Life by Earl Ubell.

BookDigest

If you had to buy all of these books in hardcover, they'd cost you $171.90. Yet you'll get them all in 2 issues of BOOK DIGEST! For less than $2.

Some material will be presented virtually intact: we'll give you a significant chapter or two. Other major selections will be sensitively edited down to an average of 25 pages each.

BD will serve as a preview of over 60 books a year, so you can select the books you wish to purchase for your personal library.

It is a good magazine to take along on a bus, train or plane trip: the selections are short enough and numerous enough so you can find several to suit your fancy at any time.

BOOK DIGEST will keep you up-to-date on the important books you will want to know about through the year.

In each issue, the author of a best-selling selection is the subject of a "Conversation" on his work and personal reflections.

A different guest columnist each issue pens a column of comment on some aspect of writing or publishing.

A "People" feature focuses on the accomplishments of those who write and make books important in our society.

And, in an 8-page special supplement, *Reviews and Recommendations,* BD will reprint vital portions of major reviews on the season's leading books.

Complimentary Copy
for Charter Subscribers.

A complimentary copy of the first issue of BOOK DIGEST is being reserved for you as part of a special offer for charter subscribers.

By filling out the coupon below, you will receive a year's subscription (six bi-monthly issues) for only $5.

You may cancel without obligation within 14 days if you are not fully satisfied. And keep the charter issue.

Reserve your complimentary first issue and enter your subscription now.

It comes to less than 10¢ a book.

Book Digest magazine.
730 5th Avenue, New York, N.Y. 10019

Please send me my complimentary copy of the charter issue of BOOK DIGEST and enroll me as a subscriber for one year at a cost of $5.00 for six bi-monthly issues, a significant saving over the newsstand price.

I understand that if I am not fully satisfied with the charter issue, I may cancel without obligation within 14 days and keep my complimentary copy.

(No need to send cash. We will be happy to bill you later.)

Name ____________________

Address ____________________

City ________ State ________ Zip ________

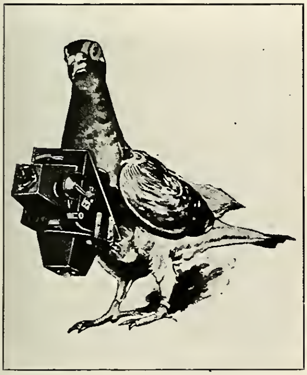
NH IC 564

The 1974
Natural History Magazine
Color Photography
Competition

If Henry David Thoreau had walked through the natural world of this century, rather than the last, he probably would have been a great nature photographer. He had all the right traits: patience, curiosity, powers of observation, sensitivity to the interrelationships of man and nature, and a natural sense of beauty, order, and timing.

Thoreau also had the luck of the good player. He was once walking with a visitor who asked him how he ever managed to find Indian artifacts. Why, they are everywhere, Thoreau replied . . . and he stooped down and picked up an arrowhead lying beside the path.

The 1974 *Natural History* Magazine Color Photography Competition is for today's Thoreaus, those good players who can find form, beauty, and art in the natural world—and who have photographic talent. With luck, one of those players will be walking along a path at the very instant that a great picture is unfolding. The photograph that emerges from that serendipitous moment will bring fame and fortune to its taker and pleasure to all readers of *Natural History*.



The Competition: We've tried to keep the categories wide. 1. The Natural World. 2. Man and His Environment. 3. A Chronological Sequence, which may be any series of up to five photographs of an event in nature.

The Rules: We've tried to keep them simple. 1. The competition is open to everyone except, of course, employees of The American Museum of Natural History. 2. Competitors may submit up to five, previously unpublished color transparencies in each category. 3. The mount of each color transparency must contain the name and address of the photographer, because keeping track of the thousands of entries is one big job. 4. For each entry we would like to know the make and model of camera, the film rating and the exposure time (if you remember it), and where the picture was taken. 5. Include a self-addressed, stamped envelope, since we will want to return the transparencies to you.

The Closing Date: We've tried to keep it short. All entries should be postmarked no later than April 15, 1974—just like your income tax.

The Reward: We've tried to keep it great. Grand Prize is a round trip for two to East Africa. First Prize in each of the categories is $250. Ten Honorable Mentions will receive $100 each.

More Rewards: All winning entries will be published in a special, color-crammed issue of *Natural History* and will be exhibited at The American Museum of Natural History.

Some Hitches: The decision of the judges will be final. *Natural History* acquires the right to publish and exhibit the winning pictures. And *Natural History* assumes no responsibility for transparencies.

An important point: Pack your beautiful transparencies carefully and mail them to:

Photography Competition
Natural History Magazine
7 West 77th Street
New York, New York 10024

the finest, strongest, lightweight, aluminum camera equipment cases in the world!

ZERO HALLIBURTON
ALUMINUM CAMERA CASES

Made by the people who created the post-recovery Apollo moon rock containers — these world-famed aluminum cases provide life-time protection for your valuable equipment. See these prestigious, ultra-rugged cases at your photo dealer or write for literature.

BERKEY MARKETING COMPANIES, INC.
P.O. Box 1060, Woodside, N. Y. 11377
In Canada: Berkey Photo (Canada) Ltd., Ontario
DIVISION OF Berkey PHOTO INC

Return to America.

Explore a forgotten America aboard the Delta Queen—last of the overnight paddle-wheel steamboats. Cruise the Mississippi and Ohio rivers that flow through our nation's heartlands and history.

There's an easy pace to riverboat life that you'll find refreshing. Speed—a relaxing 6 m.p.h.—attuned to the rhythmic splash of the paddlewheel. Scenery—virgin wilderness, quaint rivertowns, historic ports, ever-changing vistas. Diversions—dixieland jazz, calliope concerts, fine southern food, cocktails, card parties, afternoon teas, bingo.

For a brochure and '74 cruise schedule, see your travel agent or write Delta Queen,
Dept. NH,
322 E. Fourth Street, Cincinnati, Ohio 45202.

DELTA QUEEN
Voyages to America

Celestial Events

by Thomas D. Nicholson

Sun and Moon The sun is now moving to the north from the celestial equator at very nearly its maximum daily rate, bringing us longer hours of sunlight each day and a higher, brighter, warmer sun. The Northern Hemisphere, as a result, is warming noticeably.

The moon is in the dawn sky until April 20, when it will be too slim and too near the sun to be seen. After new moon on the 22nd, we should begin to see an evening crescent about the 24th, followed by first-quarter on the 29th. By May 6, when it is full, the moon will be in the sky all night long. During the second week of May, the waning gibbous moon will rise later each night. On the 14th, when it is at last-quarter, it will rise about midnight.

Stars and Planets In late April and early May, the easily recognized figure of the Big Dipper, part of the Great Bear (Ursa Major), is ideally located to help in your star finding. Look for it nearly overhead. The "pointer stars" at the end of the bowl point to the North Star (Polaris) one way, to the star Regulus and the constellation Leo the other way. Following the curved handle down the sky leads you easily to Arcturus, the brightest star of Bootes, and beyond to Spica, in Virgo.

The Lyrid meteor shower is at maximum on April 22. The radiant in Lyra is well up in the east after midnight, and there will be no moon. But this is a weak shower, about fifteen meteors per hour at maximum. The Eta Aquarid shower is at maximum on May 5, with the radiant up in the southeast from 2:00 A.M. on. Even though these are faster, brighter, and more frequent meteors, the nearly full moon will so brighten the skies as to make observing meteors difficult.

Venus and Jupiter are close together in the morning sky, visible low in the southeast from about an hour to half an hour before sunrise. Look for them especially on April 18 and 19, when the waning crescent moon will be nearby. In the evening, Mars and Saturn will be near one another in Gemini, to the right and below the twin stars Pollux and Castor in the west after sundown, setting well before midnight. Saturn is the brighter of the two planets. Again, the moon, as a waxing crescent, will make the planets more interesting when it passes near them on April 25, 26, and 27.

April 18–19: The crescent moon is near Jupiter and Venus on both mornings, to the right and above the planets in the dawn sky of the 18th, to their left on the 19th. Venus is the brighter and lower planet.

April 20: Mars and Saturn are in conjunction. Mars separates to the left (east) of Saturn after today.

April 22: The Lyrid meteors reach maximum.

April 26: Saturn and Mars are near the crescent moon in the evening sky. Saturn, the brighter planet to the right, is occulted by the moon at 10:00 A.M., EST today, but over locations well to the east and south of North America.

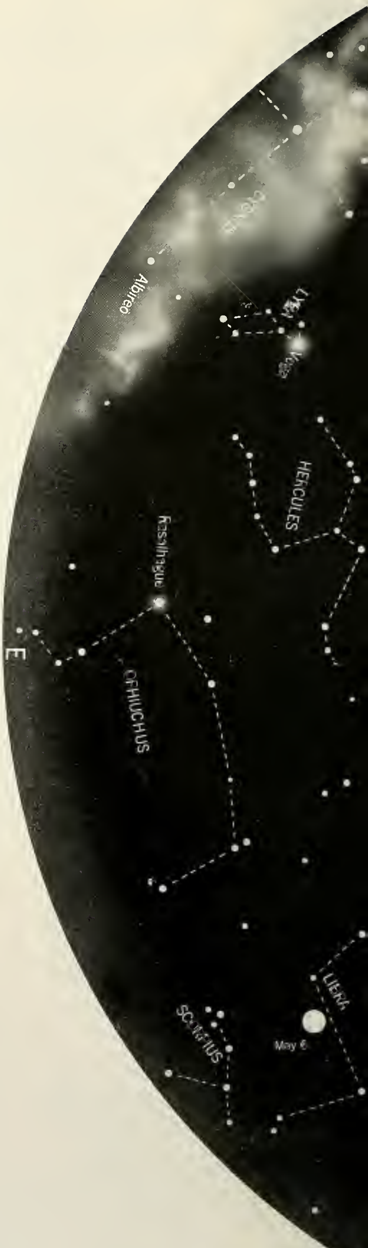
April 27: The moon is at perigee, nearest earth.

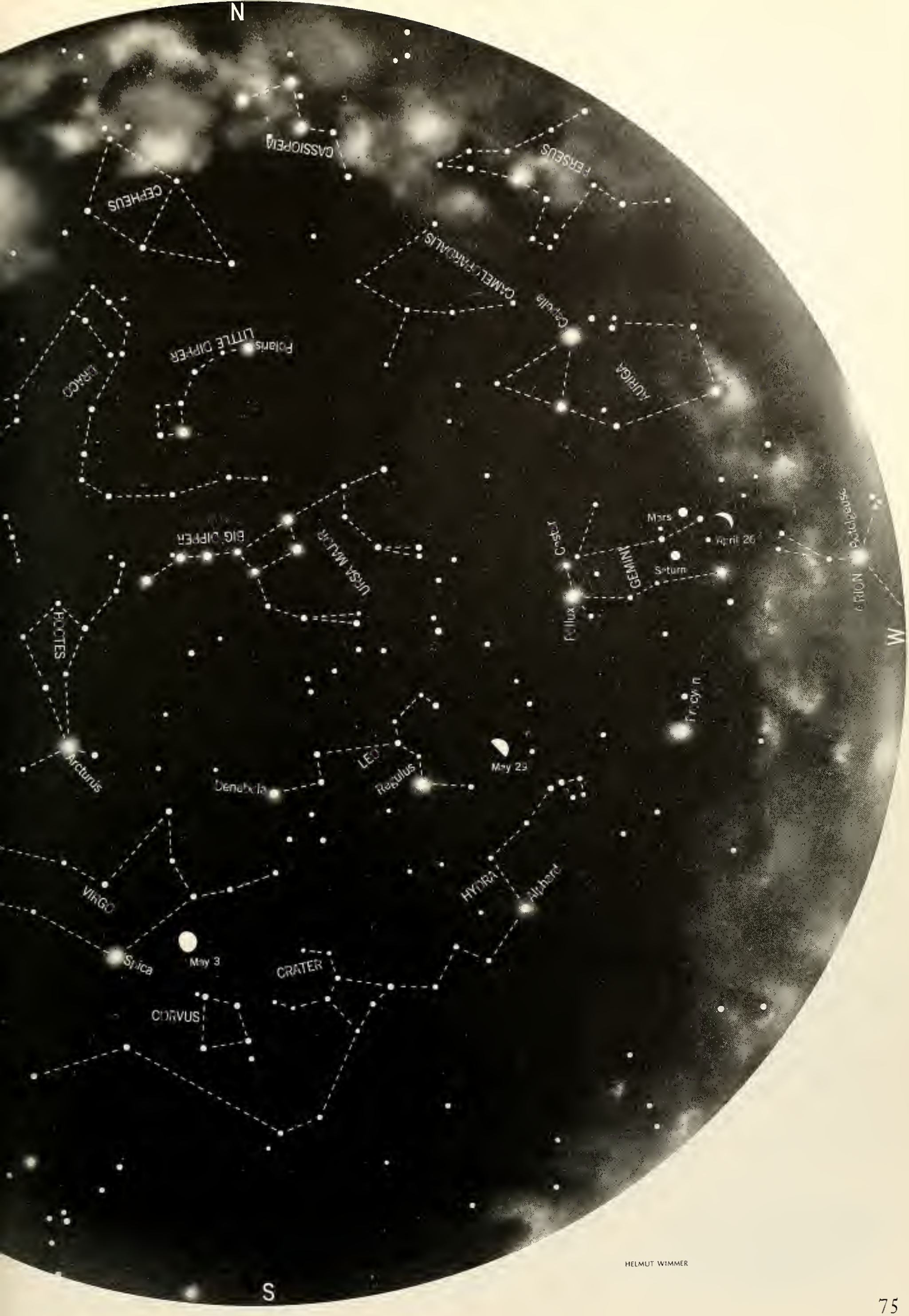
May 4: Mercury, in superior conjunction, enters the evening sky, as it moves from right to left past the sun and beyond it as seen from the earth.

May 5: Eta Aquarid meteors reach maximum. You may see some of the brighter meteors despite full moonlight.

May 12: The moon is at apogee, farthest from the earth.

★ Hold the Star Map so the compass direction you face is at the bottom, then match the stars in the lower half of the map with those in the sky near the horizon. The map is for 10:25 P.M. on April 15; 9:25 P.M. on April 30; and 8:25 P.M. on May 15; but it can be used for about an hour before and after these times.




N
CASSIOPEIA
CEPHEUS
PERSEUS
CAMELOPARDALIS
Capella
LITTLE DIPPER
Polaris
DRACO
AURIGA
BIG DIPPER
URSA MAJOR
Castor
Mars
April 26
GEMINI
Saturn
Pollux
Betelgeuse
ORION
W
BOOTES
Procyon
Arcturus
LEO
Regulus
Denebola
May 29
HYDRA
Alphard
VIRGO
Spica
May 3
CRATER
CORVUS
S

HELMUT WIMMER

The wild life of Paris.

Then the wildlife of Africa.

If you're going to Africa on safari or on business or whatever, we have a beautiful new way for you to get there.

It's called the Paris Play-Over℠. And it gives you a close-up look at the wild life of Paris for a night. You get a private room with bath at the all-new PLM Saint-Jacques Hotel.* A guided bus tour of Paris. A Continental breakfast the next day.

And you get all that for only $28.00.† That price includes your transfer, all taxes and service charges.

It's a lot of fun. And it even makes a lot of sense. Because we've made Paris the most convenient gateway to Africa there is. With 20 flights a week to the 21 largest cities. So how are you going to resist an offer like this? Send us this coupon and we'll send you all the details.

SM—A Service Mark of UTA French Airlines.
*Play-Overs also available at the deluxe Hotel Meridien as well as other 3-star and 2-star hotels.
†Per person, double occupancy.

UTA French Airlines, P.O. Box 4157,
N. Hollywood, CA 91607. Dept. 4001

Rush me your colorful brochures on UTA's African vacations, plus your special low-cost Paris Play-Overs.

Name________________

Address________________

City________________

State________ Zip________

My travel agent is________________

UTA FRENCH AIRLINES
le spécialiste longues distances

Where and How We'

The Use of Land. *A Task Force Report Sponsored by the Rockefeller Brothers Fund.* Edited by William K. Reilly. *Thomas Y. Crowell Co., $10.00; Paperback $3.95. 318 pp., illus.*

"All environmental problems," Sen. Henry Jackson observed recently, "are outgrowths of land use patterns. To a great extent, all environmental decisions are ultimately related to land use decisions."

Scrutiny of our approach to land use in this country reveals appalling anarchy. Nearly two-thirds of the nation's 3,500,000 square miles are private land. Constitutionally, jurisdiction over land use rests with the states. Historically, the states have delegated this authority largely to localities. Actual jurisdiction over land use is fragmented among some 60,000 governmental entities. The chief device localities have employed for regulating land use—and even this is relatively rare—is zoning. Zoning is mainly a means of protecting established property values: as a system of methodical land planning, it is either a disappointment or a fraud.

Land traditionally has been considered nothing more nor less than private property, and how it is used has been determined largely by the "marketplace"—the almighty dollar. As with our other environmental problems, economics has proved a disastrously inadequate regulator. "Our shorelines are being gobbled up, our wetlands dredged and filled," John R. Quarles, Jr., assistant administrator of the Environmental Protection Agency said recently. "Our mountain valleys are being dammed and flooded, our streams drastically altered by channelization, our wilderness areas cut with highways and botched with development."

Atrocities committed against the land have become so aggravated as to impel nearly all the states in recent years to institute restraints of one sort or another—wetlands controls, strip-mining regulations, "critical areas" protection—any of a dozen types of land controls. The resulting patchwork of "single-purpose" regulations is better than nothing, but it still falls far short of national land use planning. Where do we go from here?

Perhaps the most fundamental remedial development, the authors of *The Use of Land* point out, has already happened. That is a change in the *concept* of land from that of mere private property to that of a limited national resource, with an inherent public interest transcending owners' prerogatives. (This radical view, believe it or not, has been expounded by President Nixon—under the enlightened coaching of Russell Train and the Council on Environmental Quality—in three successive annual environmental messages.)

The Use of Land is a survey of how this new concept is manifesting itself, of the problems it confronts and raises, and the ways these problems may be resolved. The study was initiated by the Citizens Advisory Committee on Environmental by Gladwin Hill

Grow

Quality, an arm of the Council on Environmental Quality, and was carried out by a blue-chip panel of citizen specialists headed by Laurance Rockefeller, under the auspices of the Rockefeller Brothers Fund. William K. Reilly, a C.E.Q. staff member and recently named president of the Conservation Foundation, was executive director of the study.

While nominally focused on urban growth, the survey inevitably deals with dynamics affecting all land. Its main theme is that for at least the next generation or two—with the nation irrevocably committed biologically to a population increase of over 50 million by the year 2000—the hard line "no growth" philosophy is no answer: the answer is development coordinated with protection and enhancement of environmental values.

The crux of our land predicament is that while jurisdiction over land use still rests mainly at the local level, new problems transcend and defy piecemeal local handling—shoreline management, highway and airport location, regional air and water pollution; residential, commercial, and industrial energy development. Therefore, states must reclaim their delegated, fragmented authority and redistribute it. Several workable patterns for different sorts of problems are emerging: direct statutory controls (as with strip-mining), joint state-local commissions, local authority operating within state-set coordinative guidelines.

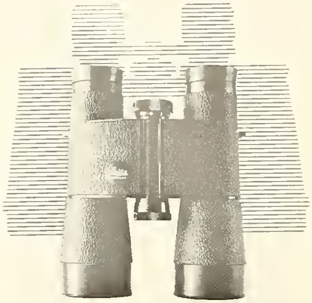
The report stresses as a prime requirement the preservation of open space (which, once gone, is almost impossible to re-create) and outlines a number of ways of doing this. It devotes much attention to the ramifications of two major legal questions implicit in comprehensive land use planning. One problem is that when you impose restraints on the use of land, you generally take away from the owner some of its immediate market value. The courts have held that municipal zoning is an exercise of police power in the public interest and outside the constitutional guarantee of just compensation for taking. But beyond this, the compensability of land controls is a gray area. The report concludes:

"It is time that the U.S. Supreme Court reexamine its earlier precedents that seem to require a balancing of public benefit against land value loss in every case, and declare that when the protection of natural, cultural or aesthetic resources or the assurance of orderly development are involved, a mere loss in land value will never be justification for invalidating the regulation of land use."

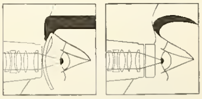
A second major legal question is population limitation. Any comprehensive city, state, or regional land use plan has to be premised on an assumption of maximum desirable population. But the Constitution guarantees citizens the right to travel freely among the states—and, inferentially, to settle.

"Clearly," the report says, "the courts are going to be asked to draw with some precision the line be-

Why the thin one is best for eyeglass wearers.



Compact, lightweight Leitz Trinovid® binoculars provide full-field viewing with no need to remove your glasses.



Trinovid's exit pupil (the point where the light rays converge) is further than usual from the eyepiece. Rubber eyecups compensate for differences in eye-relief factor: with glasses (left) eyecups are folded back; without glasses (right) they are extended. In both cases the same large exit pupil is produced.

Each hand-assembled unit is perfectly aligned to prevent eyestrain. Their superb Leitz optics are color-corrected and anti-reflection coated. The "roof prism" design and internal focusing make it possible to seal and protect all elements in an extremely thin but unusually sturdy unit.

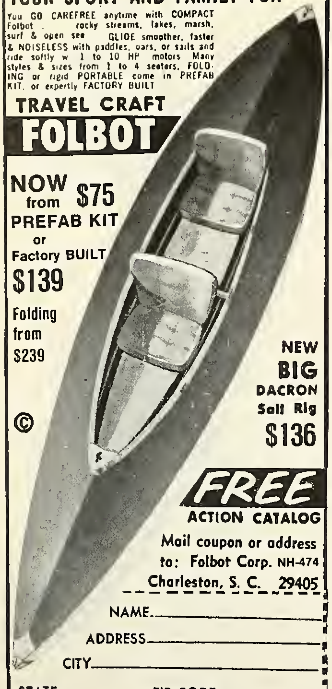
Trinovids are about twice as expensive as conventional glasses. But they are the only binoculars that offer the original owner a lifetime guarantee. (In case of a defect return the unit postpaid and Leitz will either repair or replace it at our option.)

And if you consider binoculars as an extension of your own precious optical system, buying less than the best is an unwise economy.

For a brochure write E. Leitz, Inc., Rockleigh, New Jersey 07646.

Leitz

The only binoculars with a lifetime guarantee.



YOUR SPORT AND FAMILY FUN

You GO CAREFREE anytime with COMPACT Folbot . rocky streams, lakes, marsh, surf & open see GLIDE smoother, faster & NOISELESS with paddles, oars, or sails and ride softly w 1 to 10 HP motors Many styles & sizes from 1 to 4 seaters, FOLDING or rigid PORTABLE come in PREFAB KIT, or expertly FACTORY BUILT

TRAVEL CRAFT
FOLBOT

NOW from $75
PREFAB KIT
or
Factory BUILT
$139

Folding from $239

©

NEW BIG DACRON Sail Rig
$136

FREE
ACTION CATALOG
Mail coupon or address to: Folbot Corp. NH-474
Charleston, S. C. 29405

NAME__________
ADDRESS__________
CITY__________
STATE__________ZIP CODE__________

THE ORIENTAL ART OF BONSAI
BONSAI
IMPORTED FROM JAPAN AND CHINA
FOR HOME, OFFICE OR AS THE PERFECT GIFT IDEA

A LIVING MINIATURE TREE, REFLECTING THE PASSING YEARS IN ITS GNARLED TRUNK AND TWISTED BRANCHES. EACH NEW SEASON BRINGS WITH IT FLOWERS, BERRIES AND CHANGING COLOR. IF YOU CAN WAIT JUST ONE WEEK, WE WILL DELIVER A TREE THAT HAS WAITED ALMOST TWENTY YEARS.

HEIROB BONSAI NURSERY, INC.
Willowemoc Road, Livingston Manor, New York 12758
PHONE ORDERS ACCEPTED (914) 439-5706 NH

Quantity
☐ 12" Japanese Flowering Quince
☐ 8" Blue Moss Cypress
☐ 10" Japanese Cedar
☐ 8" Japanese Elm
☐ 12" Japanese Juniper
☐ 1 Tree.... $34.50
☐ 2 Trees......66.00
☐ 3 Trees......97.00
☐ 4 Trees....125.00
☐ 5 Trees....150.00
☐ Catalogue

Books on Bonsai
☐ Bonsai, Saikei and Bonkei, $9.00
☐ Introductory Bonsai $7.00
☐ Bonsai for Beginners $6.00
☐ 5 Pce Bonsai Tool Kit, $19.95
☐ 6 Pce Deluxe Bonsai Tool Set in Zippered Pouch, $35.00

Prices include delivery anywhere in North America

Enclosed is my check or M.O. for $__________ including sales tax where applicable.
Bill my__________credit card account for the full amount plus tax $ __________
☐☐☐ ☐☐☐ ☐☐☐ ☐ ☐☐☐
Exp. Date__________MC Interbank # __________
Name__________
Address__________
City__________State__________
Date__________Zip__________
Signature__________
Phone__________

tween legitimate protective regulations and improper restrictions on growth and mobility. The line they draw, and the responsive measures adopted by governments as that line becomes clearer, will have a major influence on how and where we grow."

The report presents 63 recommendations, ranging from tax-structure revisions favoring open space to new controls on subdivisions. The study's glaring deficiency is its timorous and unimaginative premise that most of the 50 million or more people to be added to the population in the next 30 years must be accommodated on the fringes of existing metropolises.

Today most of the nation's population is jammed into less than 10 percent of its land area, while 90 percent of the land stands relatively unused. (There are, arithmetically, 11 acres for every man, woman, and child in the country.) This maldistribution is manifest idiocy, and a start on remedying idiocy can't be made too soon. The fact that no national administration has had the guts to come to grips with this situation does not make it any more acceptable.

In 1969, the National Commission on Urban Growth recommended that 10 new communities of one million people each, and 100 new communities of 100,000 people each, be developed to accommodate 20 million or more of the expected population increase. The Nixon administration, characteristically terrified at the thought of any such bold program, plunged its head in the sand and left direly needed population redistribution to the tender care of such demographic abortionists as Boise Cascade, with its record of irrational, deceit-ridden, hit-and-run development. *The Use of Land* pays some wordy academic lip service to the "new communities" idea, but concludes a priori that "most development is going to take place at [sic] scales smaller than new communities." This seems an unnecessarily reactionary posture in a document that otherwise is progressive.

Another "critical area" left unexplored—possibly because it will take one or more task force studies by itself to elucidate—is the necessity of radically altered municipal financing to complement real land use planning. Cities now get two-thirds of their revenue from real estate taxes, and the reason cities generally are such messes is that the prime criterion in designating land uses always has been: "What will bring in the most tax revenue tomorrow?" Any subordination of this yardstick to environmental values obviously will mean lower immediate tax revenues than a purely mercenary policy would garner. Any such prospective decrease will be seized upon and exaggerated by the many opponents of land controls to maintain the grisly status quo. It would seem that this problem will have to be resolved in advance by planning advocates, with blueprints for model progressive municipal fiscal systems, before their cause will be politically viable.

But on the whole one is disinclined to be too critical of the task force's work. One milestone in the movement toward sensible land use was the 1972 publication of the C.E.Q.-sponsored study *The Quiet Revolution in Land Use Controls* by Fred Bosselman and David Callies; *The Use of Land* is another.

Gladwin Hill is the national environmental correspondent for The New York Times.

Africa Counts, by Claudia Zaslavsky. *Prindle, Weber & Schmidt, $12.50; 328 pp., illus.*

I count it a pleasure to review *Africa Counts*, a book that reflects the dignity, the variety, and the richness of the African experience. In her well-written, handsomely illustrated book, Zaslavsky has made possible an encounter with much that is memorable in African culture. She has read widely and had personal contact with Africans of many parts of the continent, and she recounts these experiences gracefully.

Mainly concerned with mathematics, Zaslavsky goes well beyond that subject, discussing African recreation, folklore, cultural anthropology, history, and the origins of thought. All of these matters "count" for a great deal in presenting Africa to the reader, but they are often only peripherally related to "counting," to measurement, or to shape. This helps enliven the book, and I intend to recommend it to my African students, who at times lose sight of the richness of their own intellectual heritage.

The portions of the book that deal explicitly with mathematical matters are very well done indeed. The author's discussion of counting systems is careful and thorough. She deals with the various number bases for verbal number systems and clearly shows the relation of these verbal systems to gesture counting. There is a real correspondence in certain African societies between the names of the numbers and the ways in which those numbers are indicated with the fingers. Her discussion of the things that are counted, particularly the cowrie shells that formerly provided the currency for much of sub-Saharan Africa, is illuminating.

Weights, measures, and record keeping are well treated in the book, although more detail would have been useful, considering the importance of measurement in applied mathematics. A more thorough discussion of the systems of measurement of cloth and other commodities in African cultures would also have been welcome.

Zaslavsky is very persuasive when she deals with the uses of shapes in art and textile design. Her discussion of patterns is clear, articulate, and highly relevant to the abstract mathematics she wishes to display in the African tradition. She finds design present throughout the continent, and with clear and well-chosen photographs, she shows not only its mathematical structures but also its importance for African cultures. The next step might have been to discuss how the people who use these design systems articulate them. My experience in Africa is that rules of reasoning are known, although not expressed in the form to which Western mathematicians are accustomed.

As she moves away from mathematics and into folklore and the description of culture, Zaslavsky's discussion seems somewhat less precise. For instance, in considering African ideas of time in the section entitled "Numbers in Daily Life," she denies the force of that heading by showing that these African ideas of time have more to do with the quality of the moment than with number.

Her historical discussions are weak. She places bits of historical information at the beginnings of sections of the book. Perhaps these sections will help the reader who is new to Africa, but I think they would be more helpful if they were better organized and more clearly related to the rest of the text.

Finally, I must disagree with some of Zaslavsky's speculations about early history and economics. In a book devoted to Africa south of the Sahara, she includes lengthy sections on hypothetical relations between black Africa and ancient Egypt. The Egyptian *Book of the Dead* reports finger counting, which is supposed to relate to present-day African gesture counting. Egyptian carvings are later cited to support the relation, for example, a design similar to a present-day game is carved into a roof slab in an Egyptian temple. I find such speculative connections unconvincing as well as unnecessary to the exposition of contemporary Africa.

As another example, in a book that is descriptive of the place of mathematics in culture, she asserts the relation between economic de-

You can *feel* their presence in your home...

Let these fine collector's editions add new color and elegance to your surroundings . . .

The Heritage Club selects titles from the world's greatest literature and turns them over to celebrated designers, artists, typographers, printers and binders, who combine their talents to produce superb volumes that lend beauty, grace and sophistication to your library.

The kinds of books we offer are available *only* from The Heritage Club. They are sturdier and handsomer in every way than the average book; the bindings range through a variety of colors and materials; each volume comes in a durable slipcase to protect it from dust and wear. Yet these beautiful editions cost no more than the average fiction or non-fiction work.

The Heritage Club
Avon, Connecticut 06001

Please send me complete information about your books.
There is, of course, no obligation.

Name

Address

City State Zip

TRAVEL THE WORLD OF LINDBLAD

2300 miles up the world's largest highway—

THE AMAZON RIVER

Lars-Eric Lindblad, who pioneered those memorable cruising expeditions from the Atlantic Ocean all the way to Iquitos in the foothills of the Andes has scheduled two more adventures on the Amazon this fall. Very few people have ever seen this verdant jungle world as you will. Explore shore lines in Zodiac rubber rafts, listen to howler monkeys. Marvel at the pink dolphin playing in the shallow waters, and along the river's edge witness hundreds of forest birds and tropical fish. We will visit primitive tribes in quaint villages and towns. The M/S Lindblad Explorer* is fully air-conditioned with all the comfort you can ask for. She is operated in the famed tradition of the Swedish American Line. The two expeditions are scheduled for October and November and we suggest you make your reservations early. Please write for our informative brochure if you are seriously interested.

LINDBLAD TRAVEL, INC.
Dept NHAR 474
133 East 55th Street, New York, N Y 10022
(212) 751-2300

*Panamanian registry

Nikon wants you to see better

Nikon prism binoculars start with world-famous Nikon optics, made from Nikon optical glass. Lenses and prisms for right and left barrels are precisely matched and collimated, and the optical parallelism of both barrels is verified.

That's why with Nikon binoculars you enjoy brilliant, sharp, full-field viewing without strain or fatigue, even for long stretches. Now, find out how little more it costs to see better, longer. At Nikon camera dealers and selected optical departments. Write for literature Folio 18, Nikon Inc., Garden City, N.Y. 11530. Subsidiary/Ehrenreich Photo-Optical Industries, Inc. EPOI
(In Canada: Anglophoto Ltd., P.Q.)

Nikon Binoculars

velopment and the growth of number concepts. It seems to me, however, that her own evidence supports the relative independence of these two areas, as in the case of the Masai, who have resisted a monetized and enumerated economy and yet have sophisticated number concepts. Such speculations seem to me to detract from what is generally a valuable descriptive survey.

Nevertheless this is a fine book, despite the shortcomings I have noted. It will serve students of Africa well and should arouse the interest of many others. The numerous and well-chosen illustrations, the lively style, the specific details, and the breadth of learning, all help the reader who wishes to understand more of mathematics and its place in society, specifically African society.

John Gay
Cuttington College
Monrovia, Liberia

THE DDT MYTH, by Rita Gray Beatty. *The John Day Company, $6.95; 201 pp.*

The pro-DDT clique embraces chemical industry types, food growers and processors, agribusinessmen, mosquito abaters, government pest controllers, ag-college grunts, and a sprinkling of just plain folks hung-up over hippies, eco-freaks, organic food fanatics, and doomsday prophets. What unifies this group is its conviction that the ban on DDT is part of a conspiracy against free enterprise and technology. In its fervor to protect our way of life and assure unfettered technology, the DDT group ignores or rejects the experimental evidence of DDT's ecological faults. Now, in Rita Gray Beatty's book they have a beacon that casts "true" light on the DDT issue. Any question as to the book's objective is quickly answered by perusing the list of Beatty's advisers, which reads like a Committee to Document and Confirm the Benign and Miraculous Nature of Dichloro Diphenyl Trichloroethane. The indicator of what is to come appears in the preface, where Beatty, following F. A. Gunther's foreword extolling her impartiality, feels it necessary to deny support from, or affiliation with, any company, corporation, institution, organization, or individual.

In other words, this book promotes DDT; to this end it is loaded with unsupportable generalizations, shocking errors, and omissions of fact. For example, it ignores the DDT-connected problems of the western grebe in California, the bald eagle in Florida, Alaskan falcons and hawks, and the osprey and other raptors in England. Instead, it focuses on situations where the effect of DDT is clouded, endeavoring to use these to discredit the entire story of the insecticide's adverse effect on avian reproduction. One of the unsupportable generalizations is that DDT controls encephalitis, when in fact, California's worst outbreak occurred after the vector mosquito became resistant to the material.

Beatty really gets into deep water when she discusses DDT in cotton. Here she is guilty of bad reporting as well as omissions of fact. Thus, in one place she writes of the severe impact of the tobacco budworm on a Texas tobacco industry that never existed, cotton being the affected crop. At another point she describes the destruction of the cotton industry at Tampico, Texas, when what she apparently had in mind was an incident that occurred at Tampico, Mexico. Then, as a topper, she credits the DDT ban with the destruction of the cotton industry in northeast Mexico, an area where the insecticide was never banned.

Again, concerning cotton, she paints an ugly picture of the deadly hazard posed by the insecticide parathion, a common substitute for DDT. She implies that the heavy usage of parathion in cotton resulted from the DDT ban, when in fact parathion had been intensively used for years against the boll weevil, which became resistant to DDT in the 1950s.

Beatty's comments on the economic impact of the DDT ban are ludicrous. For example, she reports a striking decline in the California cotton yield immediately after the withdrawal of DDT, but conveniently ignores the fact that in the second year of the ban the yield was the highest in half a decade. Then she cites an outlandish claim that the DDT ban caused a sevenfold increase in California cotton production costs. If true, this would have

TRAVEL THE WORLD OF LINDBLAD

Short of the moon—this is as far as you will travel on earth!

ANTARCTICA

For the tenth consecutive year, Lars-Eric Lindblad invites you to see this last frontier on our shrinking planet. Our decade of travel to the south polar regions has given us a body of experience no one else can even approach. You will experience the thrill of treading on land which until recently was reserved only for explorers. Four expeditions starting at the end of this year will feature the Falkland Islands as well as Antarctica. In addition, the first will also include the South Georgia Islands—the famed whaling stations of years past.

The MS Lindblad Explorer* operated in the great tradition of the Swedish American Line, will provide all the comforts you can ask for. Because of the immense popularity of these expeditions, we suggest you make your reservations early. Please write for our Antarctica brochure only if you are seriously interested.

LINDBLAD TRAVEL, INC.
Dept NH AR 474
133 East 55th Street, New York, N Y 10022
(212) 751-2300

*Panamanian registry

It's like a long, fascinating walk in a beautiful garden.

Famous Wayside Gardens Catalog
216 pages, packed with 1,900 varieties of trees, shrubs, perennials, roses.

WAYSIDE GARDENS
1974

New 1974 Edition, $2.00
- 88 pages of perennials.
- 78 pages of trees, shrubs and fruits.
- 14 pages of roses.
- 19 pages of bulbs and tubers.

Plus many pages of annuals, herbs and vines . . . and dozens of help-to-grow items.

OPENS THE DOOR TO BEAUTIFUL GARDENS.
Hundreds of ideas in beautiful color from one of America's most respected nurseries help you plan and plant the most exciting garden in your neighborhood.

A GUARANTEE THAT MEANS WHAT IT SAYS.
Your order will arrive in good growing condition. And, even if you goof up later (up to 6 months later) through forgetfulness or inexperience, we'll stand half the replacement cost. That's our guarantee!

MORE THAN A CATALOG, IT'S A REFERENCE BOOK.
The Wayside Catalog contains clear, accurate descriptions of each item, plus botanical names, colors, sizes, blooming periods, planting tips and much more.

PLUS AUTUMN CATALOG. NO EXTRA COST.
With the regular catalog, you receive at no additional cost the Autumn Catalog—80 pages of Spring blooming offerings. Reg. $1 value.

WAYSIDE GARDENS 651 Mentor Avenue, Mentor, Ohio 44060
Enclosed is $2.00. Rush my new Wayside Catalog. I understand that my catalog will contain a $2 credit certificate and that my satisfaction is guaranteed.

Name
Address
City State Zip

meant an average expenditure of over $1,000 per acre in a crop that only grossed about $300 to $400 per acre. Anyone associated with California cotton knows that such a cost increase would have bankrupted the industry. A final shocker is Beatty's denial of the balance of nature in support of her argument that species extinction is not a bad thing, and her turnaround in citing natural enemy destruction to explain why parathion triggers bollworm outbreaks.

The DDT Myth is part of a determined effort to lift the DDT ban and discredit those who support it. The book's weaknesses will dull its effect, but the tactics employed by its author and the DDT group are cause for deep concern among those who fret over environmental quality.

ROBERT VAN DEN BOSCH
University of California, Berkeley

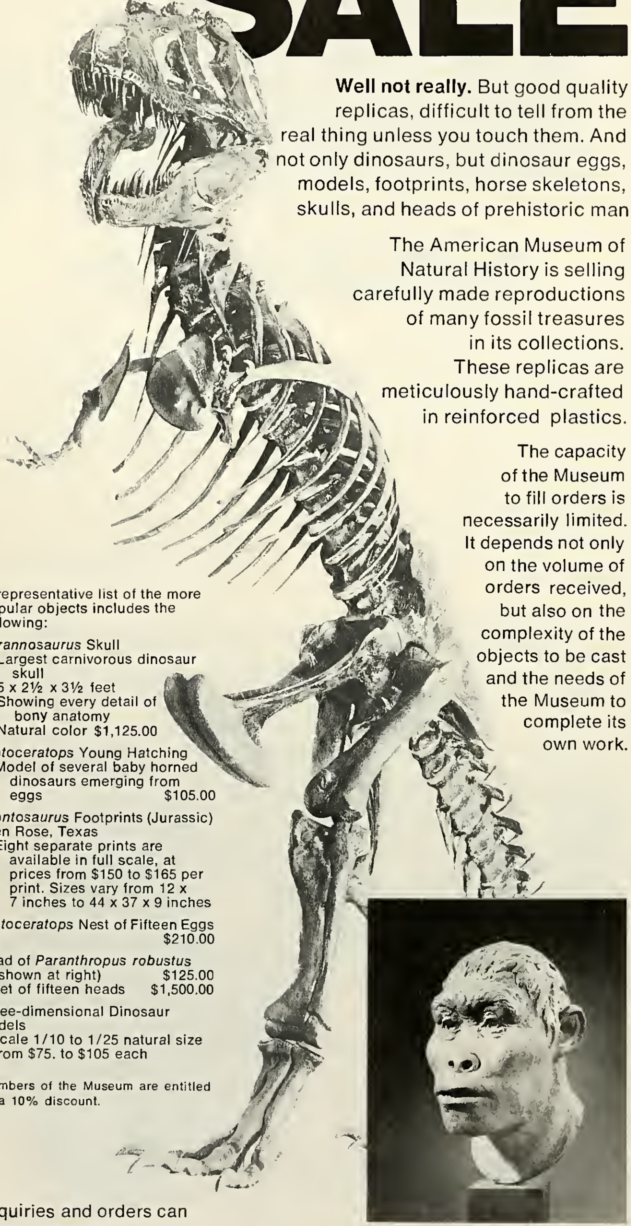
MYSTERY OF THE MAYA, *a film produced for* WNET *by Hugh and Suzanne Johnston. Narrator, Ricardo Montalbán. Photography and editing by Hugh Johnston. Special photography by José del Carmen and Ian Graham. Broadcast nationally over Public Broadcasting Service, Monday, April 1, 1974.*

This seventy-five-minute film, with a script approved by some of the most outstanding Maya scholars, suggests a painstakingly careful endeavor to portray accurately the Maya civilization.

Mystery of the Maya is a documentary that tells of the glorious past of the ancient Maya, and the task confronting archeologists in excavating and preserving this great civilization, and also shows us the lives of contemporary Indians as they engage in their arduous daily routines. The vignettes of the present-day Indians concern their religious beliefs, the planting and harvesting of corn, the festivals that reflect their seasonal occupations, and the laborious tasks of women and men eking out a living.

The film is most impressive when it is following the jungle trampings of the noted scholar Ian Graham as he uncovers monumental sculptures in some of the remote regions of the Petén. It is imperative that we record these monuments and their

DINOSAURS FOR SALE



Well not really. But good quality replicas, difficult to tell from the real thing unless you touch them. And not only dinosaurs, but dinosaur eggs, models, footprints, horse skeletons, skulls, and heads of prehistoric man

The American Museum of Natural History is selling carefully made reproductions of many fossil treasures in its collections. These replicas are meticulously hand-crafted in reinforced plastics.

The capacity of the Museum to fill orders is necessarily limited. It depends not only on the volume of orders received, but also on the complexity of the objects to be cast and the needs of the Museum to complete its own work.

A representative list of the more popular objects includes the following:

Tyrannosaurus Skull
  Largest carnivorous dinosaur skull
  5 x 2½ x 3½ feet
  Showing every detail of bony anatomy
  Natural color $1,125.00

Protoceratops Young Hatching
  Model of several baby horned dinosaurs emerging from eggs $105.00

Brontosaurus Footprints (Jurassic) Glen Rose, Texas
  Eight separate prints are available in full scale, at prices from $150 to $165 per print. Sizes vary from 12 x 7 inches to 44 x 37 x 9 inches

Protoceratops Nest of Fifteen Eggs $210.00

Head of *Paranthropus robustus*
  (shown at right) $125.00
  set of fifteen heads $1,500.00

Three-dimensional Dinosaur Models
  scale 1/10 to 1/25 natural size
  from $75. to $105 each

Members of the Museum are entitled to a 10% discount.

Inquiries and orders can be addressed to:

Department of Exhibition and Graphics
The American Museum of Natural History
79th Street and Central Park West New York, N.Y. 10024

glyphic inscriptions before vandals destroy forever the record of Maya accomplishments.

A quick view of the famed Bonampak murals; some narrative pottery, showing dramatic scenes of the gods painted in dashing, cryptic brush strokes; and fleeting glimpses of some of the great architectural wonders of this extremely important civilization document the ancient Maya of Classic times.

The latter part of the film deals with the rediscovery of a Late Classic Maya temple, which was first discovered in 1912 near Río Bec in Yucatan.

Unfortunately, I reviewed the film from a cassette showing, and I know that transference to a cassette can be disastrous to color and light. But I am sure the original film, as seen on television, must be quite beautiful.

Seen in proper color, the wild jungle life of spider and howler monkeys swinging from treetops, tropical oropendola birds nesting, and other aspects of nature can be breathtakingly lovely.

Why the film refers to the Maya as a "mystery" civilization in regard to its beginnings and ending is something I don't really understand. In my opinion the beginnings of the Maya civilization are no more of a mystery than that of other Mesoamerican civilizations or, for that matter, the ancient civilizations of the Mediterranean. In this film the reasons given for the end of the Maya civilization are those that were given some thirty-odd years ago and that have been repeated too often since then. Recent research has revealed other reasons for the collapse of the Maya in Classic times, for instance, intrusive groups of Mexicans who perpetually invaded the Maya area for many centuries. Even after the collapse of the Maya at the end of the Classic Period, intensive building programs still continued both in the Guatemala highlands and in the Yucatan Peninsula, but the style was decadent and eclectic. These points are not made in *Mystery of the Maya*, but this is an extremely minor criticism. Of all the many, and often disappointing, films on Mesoamerican civilizations that have appeared recently, this film is certainly the best produced to date.

C. Bruce Hunter
The American Museum

TRAVEL THE WORLD OF LINDBLAD

Journeys into Antiquity

Lars-Eric Lindblad offers three journeys of classic beauty into Egypt's ancient past You may desire to travel A Thousand Miles Up The Nile You may want to explore The Blue & White Nile, which includes an expedition into Ethiopia Or you may want to embark on a journey to Lands Of Antiquity which, in addition to Egypt, will take you to Greece and some of its historic islands These three tours feature unique and exciting excursions into unrivaled archeological places You will marvel at the sight of great temples and relics of true antiquity **BOAC-British Airways** will fly you there and back in great comfort. Write for our informative brochure

LINDBLAD TRAVEL, INC.
Dept NH N 474
133 East 55th Street New York N Y 10022
(212) 751-2300

Because they're birds and they're free! So you have to change your photo habits. One ingenious solution is a zoom lens. It gives you a fast change of focal lengths without moving the camera from your eye.

The Vivitar Automatic Zoom lens goes from 85 to 205mm, opens up to an impressive f3.8 and isn't any larger than most standard 200mm lenses. The highly sophisticated optical design has 13 elements in 9 groups. The Vivitar Automatic Zoom will fit the automatic mounts of the Nikon F, Pentax, Nikkomat, Mamiya/Sekor, Minolta and Canon cameras.

See a demo at your photo dealer or write for test reports by leading photo magazines.

Vivitar Zoom lenses

Marketed in the U.S.A. by
Ponder&Best, Inc.,
1630 Stewart Street,
Santa Monica, California 90406.
In Canada: Precision
Cameras of Canada, Ltd.

Why don't birds stay where they are while you change lenses?

BOB CAMPBELL

We'll die ..!

Survival of the fittest and fleetest on E. Africa's plains is hard enough, without poachers, their snares and fires added to our battle. They, and those who sent them, are after our skins, hides, furs, claws, hooves, horns and teeth. But believe me, we need them more than they. However if we don't get help soon, we'll go the same way as the Dodo. To extinction.

You are our hope and our help, and the link between us is the EAST AFRICAN WILD LIFE SOCIETY, East Africa's own conservation group, and the first of its kind in the tri-nation area of Kenya, Uganda and Tanzania.

It is non-profit, non-governmental, a body that has funded a list of conservation projects since 1961, as long as your arm. Every cent of your membership (US$11.00) goes directly to game conservation projects; and not one cent to "overheads".

THE *WILDLIFE* GETS ALL THAT YOU GIVE

As a member of the Society you will also receive a year's subscription to AFRICANA the quarterly wildlife magazine. And for those who are interested in gifts of every description which have to do with the game of East Africa, a 32 page colour brochure is available for US$ 1.00. They are also on sale from our gift shop and gallery in the Nairobi Hilton Hotel.

And while you're reading this, remember, that the Society is working round the clock on our behalf, in the field of education, anti poaching, research and animal rescue.

USA Representative:
Miss Alice Smith Box 1325, Chicago Ill. 60690

EAST AFRICAN WILD LIFE SOCIETY
Box 20110 Nairobi Kenya.

Please enrol me as a member.
I enclose US.$11.00 for my year's membership.

Name ____________
Address. ____________
____
____

Photograph Want List

Readers are invited to submit for possible publication photographs of the following: mosquitoes in flight; primate aggression in the wild; mangabey and colobus monkeys; nomads of Pakistani Baluchistan; a sharp sequence of an eagle taking or stealing prey. Pictures, which will be paid for at professional rates if used, should be mailed to:

Photograph Editor
Natural History Magazine
Central Park West at 79th Street
New York, N.Y. 10024

Notice: The sending of film to us will constitute an agreement by you that if any such film is damaged or lost by us it will be replaced with an equivalent amount of unexposed film. Except for such replacement, the handling of such film by us is without liability.

WHEN YOU WRITE TO NATURAL HISTORY

about a change of address, renewal of subscription, billing, or any kind of adjustment, send the present address label from the magazine wrapper.

Moving? Please notify 6 weeks in advance.
You can use this form to tell us about a move or order a subscription.

Change of address—attach your address label in the dotted area and fill in your new address below, clip and mail to: Natural History Magazine. Membership Services, Box 6000, Des Moines, Iowa 50306.

A new subscription—Check box and fill in name and address below.

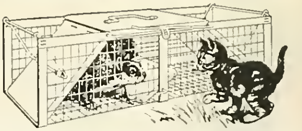
- ☐ 1 year—$8
- ☐ 2 years—$15
- ☐ 3 years—$21

(Add $2 per year to Canada and other non-U.S. orders)

Cut your old address label from magazine wrapper and attach over this area.
Fill in your NEW address below and mail to:
Natural History Magazine
Membership Services Box 6000
Des Moines, Iowa 50306

H001

PLEASE PRINT
Name ____________
New Address ____________
City ____________ State ____________ Zip ____________



CATCH THEM ALIVE AND UNHURT!

Amazing HAVAHART trap captures raiding rats, rabbits, squirrels, skunks, weasels, etc. Takes mink, coons without injury. Straying pets, poultry released unhurt. Easy to use—open ends give animal confidence. No springs to break. Sizes for all needs. FREE booklet on trapping secrets.
HAVAHART, 158 Water St., Ossining, N. Y. 10562
Please send new guide and price list.
Name ____________
Address ____________ Zip ______

African
Village handicrafts, beads, hangings. Illustrated catalog $1
AFRICA P.O. Box 49N, N.Y.C. 10003

YOU DON'T HAVE TO
BE RICH TO HAVE
A GREENHOUSE!
Write for our catalog.
TURNER GREENHOUSES
Mt. Olive Highway, Goldsboro, N. C. 27530

CRYSTALAIRE CAMP FOR BOYS AND GIRLS
Frankfort, Michigan
Separate girls and coed sessions, ages 10-15. On Crystal Lake in North Michigan dune country. Flexible, individualized program 3, 6, 9 weeks. Outdoor exploration stressed. ACA accredited. All races and creeds welcome. Write:
T. N. Speyer
Innisfree, Maple City, Mich. 49664

FIFTY JUNGLE BUTTERFLIES $2.95
THIRTY EXOTIC SEASHELLS $1.95
FIFTEEN BEETLES—WORLDWIDE $3.25
EIGHTEEN GEM-STONES $2.25
PLUS giant Natural Hobbies Bargain List
with many school projects and gift suggestions.
Dept.H,Collectors'Wonderland-Box 1170,N.Y.10008

Send 50¢ for Illustrated Catalog
SHELLS, MINERALS, FOSSILS, INDIAN ARTIFACTS
DOVER SCIENTIFIC
Box 6011 C Long Island City, N.Y. 11106

Comfortable Old Shrines

Continued from page 46

But the church's sharp attack on the shrine has tempered the views of circumspect townsmen. No shrine has ever been recognized by Rome—although those at Lourdes and Fátima have the aura of official sanction. Old shrines and the church have learned to tolerate each other, but new shrines are points of friction between the believers and the church.

Older shrines are not as emotionally wearing on the community itself. They incorporate a sense of joy and celebration and they provide occasions for communal pleasure. A controversial new shrine, however, demands devotional and mystical solemnity. There is little sense of spiritual or corporeal celebration, and the participants cannot afford to stand back and smile at their own zeal or that of their fellows.

Shrines do not generally promulgate social values, nor do they offer the promise of revitalization and change. In contrast, they can divert and depress social energy. Young priests raised in the spirit of the ecumenical council complain that the shrines are controlled by the towns' powerful citizens, who want to prevent the social ideals of Christianity from emerging from the cocoon of ritual and legend. In the absence of an open political system, these priests see Christianity as society's most significant force for social justice. In their view, ideas of social and economic equality cannot emerge from beneath the patina of miracle paintings nor be heard above the din of the *romeria.* The new visionary experiences and the plethora of fresh miracles are still more objectionable. As one priest protested: "The miracle is that God created man. One doesn't need to look for other miracles."

The continuance of old shrines and the emergence of new ones are proof that the contrasting belief systems make predictions concerning the future of shrines impossible. There are, after all, various levels of skepticism. As the wife of a shoemaker, herself uncertain about the validity of the new visions, noted: "The appearance of the Virgin is possible—certainly more possible than going to the moon. That never was possible and never will be." ☐

Tables by Davis

"From timber-to-tables"

Featuring American Black Walnut
(Juglans Nigra)
The Aristocrat of Wood
(Native only to America)

In our showroom you can find rich grained tables of many styles and a large selection of table tops awaiting leg fabrication. These 2" thick pieces of varied widths and lengths are the result of years of selective searching for "Great Walnut Trees," past their prime, overaged and stagging out. These trees are ready for harvest—then crafted "to live again" in nature's own design.

We make coffee, dining, end and conference tables—bars, benches, wall plaques. Deep wildlife handcarving on table corners by order. All pieces are kiln dried and have a hand rubbed Danish Oil Finish. Prices based on size, shape and grain. Call for appointment—let us help you create your Table. Brochure on request.

Dining table
7' x 40"
$675

Crotched coffee table
4' x 18" $175.00

36" Disc glass top.
$275

Dining trestle
7' x 36-40" $675
Free Form or Formal

TABLES BY DAVIS
84 Forest Road Milford, Conn. 06460
Phone 203-874-7184 or 874-1861 (Conn. Turnpike Exit 39)

We're a bridge between science and you.

We're Educational Expeditions International, a non-profit organization that offers men and women of all ages the opportunity to join prominent scientists in research projects around the world. Become part of an expedition team in archaeology, anthropology, astronomy, ecology, geology and marine sciences and contribute physically, intellectually, and financially to science. No professional qualifications are required. Team members are taught what they need to know to be productive in the field.

Marine Biology. Dr. Richard Chesher needs four teams of SCUBA divers to participate in an underwater survey of the coral reefs of Florida, now in jeopardy. April 6 to 20; September 14 to 28; October 5 to 19. $690*

Archaeology. William Waldren, director of the Deya Archaeological Museum and Research Center, will conduct a field school investigation of prehistoric cave sites on the Mediterranean island of Mallorca. July 21 to August 9; August 11 to 30; September 22 to October 5. $690, fall; $790, summer*

Dr. Alfonz Lengyel, head of the American section of a four-nation UNESCO project at Carthage begins a 5-year excavation of this ancient Punic and Phoenician site. May 19 to June 1; June 2 to 15; June 16 to 29. $690*

Dr. H. Aubrey W. Burl, head of the department of Evolution and Prehistory, Kingston-on-Hull College of Education, will excavate an unplundered stone circle cairn site of Bronze Age origin in England's Lake District. September 2 to 20. $990*

Astro-Archaeology. Dr. Gerald S. Hawkins, member of the Smithsonian Institution Astrophysical Observatory and author of *Stonehenge Decoded* and *Beyond Stonehenge* will direct two expeditions to the megaliths of Britain. Devon and Cornwall and Stonehenge August 8 to 21; Stonehenge and the Mull of Kintyre August 20 to September 2. $990.

For information about these and other expeditions, write:

eei
Educational Expeditions International Dept. NH-2
68 Leonard Street/Belmont, Massachusetts 02178
Phone: (617) 489-3030

LIVE IN THE WORLD OF TOMORROW...TODAY!

A BETTER LIFE STARTS HERE

(And our FREE CATALOG is packed with exciting and unusual ecological & physical science items—plus 4,500 finds for fun, study or profit . . . for every member of the family.)

MYSTERY OF ENERGY AND AGING

Science fact or farce? Can our Great Pyramid unlock the mysteries of energy & aging—show that the ancient Egyptians contradicted nature? Did someone really get 85 shaves from a blade kept in a pyramid? Test claims like meat not rotting, things not rusting! Users of exact scale models of Cheop's pyramid oriented to true North claim all sorts of strange phenomena based on resonating energy. Ours is already assembled, ⅛" see-thru acrylic, 6x9¼x9¼".

Stock No. 71,817E ....$20.00 Ppd.

BUILD A "FUN" WEATHER STATION

Meteorology kit can give you the know-how to check your predictions against official forecasts! Has remote reading anemometer w/windvane. Indoor indicator boerd flashes neon, shows wind speed, direction. Safety power cord holds current to less than 1 ma. Also: sensitive air-tank barometer w/2-ft. indicator column: sling psychrometer to measure rel. humidity; rain gauge that measures to 1/100th inch; 100 ft. lead-in wire; cloud chart; forecasting manual.

Stock No. 71,022E $17.00 Ppd.

"FISH" WITH A MAGNET

Go treasure hunting on the bottom! Fascinating fun & sometimes profitable! Tie a line to our 3½ lb. Magnet—drop it overboard in bay, river, lake or ocean. Troll it along bottom—your "treasured" haul can be outboard motors, anchors, other metal valuables. 3½ lb. Magnet is war surplus—Alnico V Type—Govt. cost twice our price. Lifts over 40 lbs. on land—much greater weights under water.

Stock No. 70,570E 3½ lbs..$11.50 Ppd.
Stock No. 60,215E 1½ lbs..$6.50 Ppd.

130 EXPERIMENTS IN OPTICS...

and photography! Optix® Experiments Kit is a complete optical & photography lab for 130 exciting experiments. Lets you recreate the periscope, telescope, microscope, kaleidoscope! Build a 35mm reflex camera with interchangeable lens system! Make, develop photographic film! Enjoy the fun and fascination of having your own optics lab. Fully illustr 112-pg manual, 8½x11", clearly explains usage of this stimulating kit's 114 precision engineered components.

Stock No. 71,646E ....$22.50 Ppd

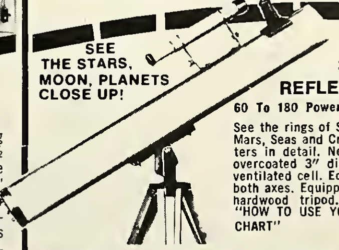
GREAT INTERNATIONAL PAPER PLANE BOOK!

Official fly-them-yourself book of paper airplanes from SCIENTIFIC AMERICAN'S "1st International Competition". Includes plans of all winning entries, time-aloft records, photos, technical data, commentaries. Has 20 unusual designs on perforated pages for easy tear-out. You won't believe how some of them fly! Amusing, entertaining. 128 pages, 9" x 11¾".

Stock No. 9391E .... $2.95 Ppd.

"STICK-PAPER AIRPLANES" BOOK Stock No. 9427E .... $4.95 Ppd.

SEE THE STARS, MOON, PLANETS CLOSE UP!



3" ASTRONOMICAL REFLECTING TELESCOPE

60 To 180 Power. Famous Mt. Palomar Type

See the rings of Saturn, the fascinating planet Mars, Seas and Craters of the Moon, Star Clusters in detail. New improved, aluminized and overcoated 3" diameter f/10 primary mirror, ventilated cell. Equatorial mount with locks on both axes. Equipped with 60x finder telescope, hardwood tripod. Included FREE: VALUABLE "HOW TO USE YOUR TELESCOPE" book;"STAR CHART"

OELUXE 3" REFLECTOR TELESCOPE Stock No. 80,162E $66.50
4¼" REFLECTOR TELESCOPE (45x to 270x) Stock No. 85,105E ....$115.00 FOB
4¼" REFLECTOR TELESCOPE WITH CLOCK ORIVE Stock No. 85,107E ....$149.95 FOB
6" REFLECTOR TELESCOPE Stock No. 85,187E ....$222.50 FOB
6" REFLECTOR W/(ELECTRIC) CLOCK ORIVE No. 85,086E ....$259.50 FOB

ORDER TODAY! COMPLETE AND MAIL

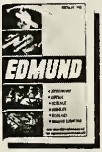
EDMUND SCIENTIFIC CO.
300 Edscorp Building, Barrington, N.J. 08007

How Many	Stock No.	Description	Price Each	Total

PLEASE SEND ☐ **GIANT FREE CATALOG "E"** MERCHANDISE TOTAL $
ADD HANDLING CHARGE: $1.00 ON ORDERS UNDER $5.00; 50¢ ON ORDERS OVER $5.00
TOTAL $

30 DAY MONEY-BACK GUARANTEE
YOU MUST BE SATISFIED OR RETURN ANY PURCHASE IN 30 DAYS FOR FULL REFUND

NAME ______________________________
ADDRESS ______________________________
CITY ______________ STATE ______________ ZIP ______
I enclose ☐ check
☐ money order for $______________



MAIL COUPON FOR GIANT FREE CATALOG!

180 PAGES • MORE THAN 4,500 UNUSUAL BARGAINS

Completely new '74 Catalog. Packed with huge selection of telescopes, microscopes, binoculars, magnets, magnifiers, prisms, photo components, ecology and Unique Lighting items, parts, kits, accesories — many hard-to-get surplus bargains. 100's of charts, illustrations. For hobbyists, experimenters, schools, industry.

EDMUND SCIENTIFIC CO.
300 Edscorp Building, Barrington, N. J. 08007
Please rush Free Giant Catalog **"E"**

Name______________________________
Address______________________________
City______________State__________Zip__________

Space Watchers:

1st flight of SKYLAB
108 color 35mm slides (27 sets) **$27.00**
2nd manned mission of SKYLAB
92 color 35mm slides (23 sets) **$23.00**
2nd mission SKYLAB color prints
8½x11" set of 12 **$2.00**
SPECIAL—48 of the most important photos from APOLLO 15, 16, 17, and the 1st SKYLAB missions $7.00
Add 50c ($2.00 overseas) mailing & handling charges for any order.
Complete catalog beginning with GEMINI IV...50c (free with order).

Space Photos
Dept.-NH-1
2608 Sunset Blvd., Houston, Texas 77005

SUMMER IN THE
WILDERNESS

Climb Adirondack and Big Horn High Peaks.
Canoe voyageur routes in Northern Ontario.
Basic and Advanced Survival Instruction.
Month long Wilderness Expeditions.
Also Weekend/*Custom*Trips:Fall,Winter,Spring
Write for definitive brochure H:
North American Wilderness Survival School
205 Lorraine Avenue, Upper Montclair,
N.J. 07043 Tel: 201-783-7711

Clear days and sparkling nights, in the high mountain valley at the base of Longs Peak, near Rocky Mountain National Park. You'll enjoy horses, hiking mountain climbing breakfast & steak rides; cookouts and cocktails by the heated pool after a packtrip. Golf course nearby. Children's counselor on duty.
Write for brochure.

swiss village
resort & guest ranch
Longs Peak route F.
Estes Park, Colorado 80517

BOOK HUNTING?

Virtually any book located—no matter how old or long out-of-print. Fiction, nonfiction. All authors, subjects. Name the book—we'll find it! (Title alone is sufficient.) Inquire, please. Write: Dept. 65.
BOOKS-ON-FILE
UNION CITY, NEW JERSEY 07087

NATURE ON STAMPS

The BIRDS & the BEES & the ANIMAL KINGDOM on GENUINE POSTAGE STAMPS.
* SAMPLES & APPROVALS – $1
Satisfaction Guaranteed
Mil Med Stamps
P.O. BOX 297-NH AURORA, CO. 80010

Additional Reading

TWO TRAVELERS (Page 16)

Scientific American, September, 1971.

ENERGY INTENSIVENESS OF PASSENGER AND FREIGHT TRANSPORT MODES 1950-1970. E. Hirst. Report EP-44, Oak Ridge National Laboratory, Oak Ridge, 1973.

ENERGY. J. Holdren and P. Herrera. Sierra Club Books, New York, 1972.

TOWARD MORE TRANSPORTATION WITH LESS ENERGY. R. A. Rice. *Technology Review*, February, 1974.

WOLF PROFILE (Page 26)

NUMBERS, TURNOVER, AND SOCIAL STRUCTURE OF THE ISLE ROYALE WOLF POPULATION. P. A. Jordan, P. C. Shelton, and D. L. Allen. *American Zoologist*, May, 1967.

WOLF PREDATION AND UNGULATE POPULATIONS. D. H. Pimlott. *American Zoologist*, May, 1967.

WOLF NUMBERS IN THE SUPERIOR NATIONAL FOREST OF MINNESOTA. L. D. Mech. USDA Forest Service Research Paper NC-97, 1973.

THE WOLF. L. D. Mech. Doubleday and Company, Inc., New York, 1970.

EVOLUTION ATTACKED (Page 32)

EVOLUTION IN ACTION. Julian Huxley. Harper and Row, Publishers, New York, 1953.

DARWIN'S CENTURY. Loren Eiseley. Doubleday and Company, Inc., New York, 1958.

GENESIS AND GEOLOGY. C. C. Gillispie. Harper and Row, Publishers, New York, 1959.

EVOLUTION, GENETICS, AND MAN. T. Dobzhansky. John Wiley and Sons, Inc., New York, 1963.

SHRINES AND VISIONS (Page 40)

PERSON AND GOD IN A SPANISH VALLEY. W. A. Christian, Jr. Seminar Press, New York, 1972.

BELMONTE DE LOS CABALLEROS. C. Lison-Tolosana. Oxford University Press, New York, 1966.

RELIGION. A. F. C. Wallace. Random House, Inc., New York, 1966.

A HISTORY OF DOCTRINE AND DEVOTION (2 vols.). M. H. Graef. Sheed and Ward, New York, 1963, 1966.

CENTRAL AMERICA (Page 48)

LIFE OF THE JUNGLE. P. W. Richards. McGraw-Hill Book Company, New York, 1970.

CELESTIAL CLUES (Page 54)

PYRAMIDS OF EGYPT. I. E. S. Edwards. The Viking Press, Inc., New York, 1972.

ABU SIMBEL. W. MacQuitty. G. P. Putnam's Sons, New York, 1965.

A HISTORY OF EGYPTIAN ARCHAEOLOGY. F. G. Bratton. Thomas Y. Crowell Company, New York, 1968.

BEYOND STONEHENGE. G. Hawkins. Harper and Row, Publishers, New York, 1973.

Give me shelter

All-purpose MPC field-tested hooded parka of windproof - waterproof coated nylon. Coated nylon lining in hood and yoke right down to its drawstring waist for double protection. Comfortable raglan sleeves. Two-way heavy duty nylon zipper. The drawstring adjusts face opening of attached hood, and hidden waist drawstring adjusts at inside back of parka. Elastic cuffs with adjustment snaps, plus two zippered slash pockets. Wear it over a sweater or Goose Down Vest or by itself in warmer weather. Colors: Sand, Red, Blue, Orange, and Green. Sizes: Men's; S,M,L,XL (Men's S and M will fit Women's Medium and Large). Weight: 12 oz. 0033 NATURALIST Parka $28.50 postpaid.

Please send my NATURALIST Parka.
My check or money order for $________
is enclosed. (Add sales tax where applicable)
Size________ Color________
Name________
Address________
City________
State________ Zip________
Satisfaction Guaranteed or Money Back

Outback
1700 York Avenue, New York, N.Y. 10028

WEST AFRICA
AKWAABA (WELCOME)

2 WEEKS FROM $1130
3 WEEKS FROM $1472
Guaranteed, Escorted, All-Expense Tours

SENEGAL
DAHOMEY
GHANA · TOGO
SIERRA LEONE
IVORY COAST
LIBERIA

Year-Round Departures from New York every other Saturday

Scantravel West Africa AKWAABA

SCANTRAVEL WEST AFRICA
c/o WDI, MUNDY INC. (Suite 1005)
Empire State Bldg., New York City 10001
PHONE (212) 868-0420-524 3795

Please send me _____ copies of your free colorful brochure describing the "West Africa Akwaaba (Welcome)" tours.
NH
Name & Title________
Company________
Street________
City________ State_____ Zip_____

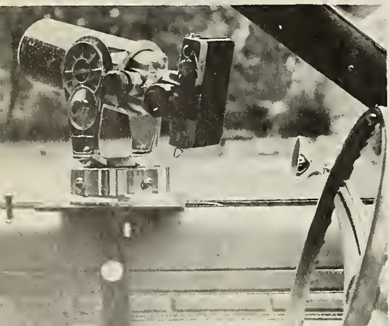
YOU SEE MORE WITH QUESTAR

Wouldn't you enjoy observing wildlife so conveniently; seeing and photographing it, at whatever the distance, in the amazing detail that only Questar can give you? And the Questar Carpod makes it so easy, no need to lug heavy equipment around in field and swamp. Questar brings your quarry right to your eye, while you relax in comfort. The burrowing owl, for example, is only 9 inches long and was caught in sharp focus at 75 feet while he was still wondering whether his careful concealment had been discovered.

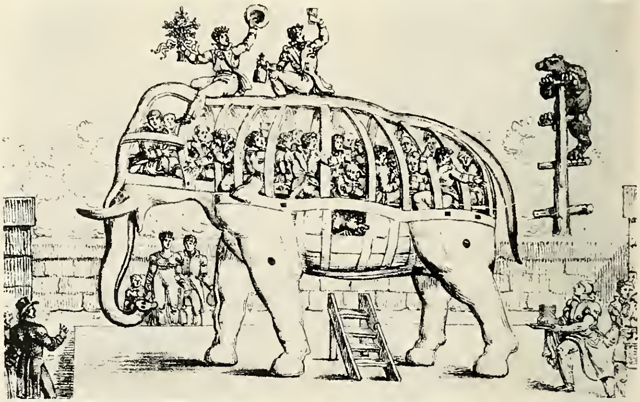
QUESTAR, WORLD'S FINEST, MOST VERSATILE TELESCOPE IS DESCRIBED IN OUR BOOKLET CONTAINING 150 PHOTOGRAPHS BY QUESTAR OWNERS. SEND $1 FOR MAILING IN N. AMERICA; BY AIR TO S. AMERICA, $2.50; EUROPE AND N. AFRICA, $3; ELSEWHERE, $3.50.

QUESTAR

Box 60-0, New Hope, Pa. 18938



Announcements



Jumbo is Back! After being in temporary retirement for the past five years, Jumbo has been engaged for a limited appearance at the Museum. The skeleton of the famous circus elephant will be on view as the April Exhibit of the Month, to the tune of band music and calliopes. When the Biology of Mammals Hall, currently undergoing modernization, reopens in 1976, Jumbo will be part of the permanent exhibit. Jumbo is important to scientists because he was a type specimen—an individual on which a scientific name is based—of *Loxodonta africana.* Then too, much was learned about large mammal taxidermy when Critchley and Akeley mounted Jumbo's skin in 1886.

Two films of anthropological interest will be shown at 2:00 P.M. on Wednesday, April 17, and again on Saturday, April 20, in the Auditorium. *Ice People* (23 minutes) portrays the conflicts between traditional Eskimo culture and modern technology. The attempts of some American Indians in northern California to preserve their heritage are recorded in *The Way of Our Fathers,* a 33-minute color presentation. Admission to the film program is free of charge to Museum visitors.

When the recently opened Rare Book Room was widely praised for its superlative resources, the **Museum Library** stood in the background like a proud, but diffident, parent. Yet the library contains one of the finest collections of natural science materials in the world and serves not only the Museum staff but also the scientific community at large. Books and manuscripts of all descriptions as well as an archival film collection can be found on the library's shelves. Many books and theses have been written here, for scholars have used these vast and often unique reference resources for many years. It is perhaps not generally known that the library has a reference/research service—people may write to the library or come in person with their questions on scientific matters, and they will be assisted by the well-informed staff. While the library does not lend books to individuals, it does, upon request, provide materials on loan to other libraries all over the country. Open to the public on weekdays from 11:00 A.M. to 4:00 P.M., the library is a remarkable institution within an institution.

An Anthropologist Looks at Music. Scheduled for April 30, this slide lecture is one of a series on anthropological topics to be held on Tuesdays, at 2:00 P.M. in the People Center. For a full listing of the schedule, write to the Department of Education or stop off at the Information Desk on your next visit here.

SMIRNOFF SILVER®
1877
1886
PURVEYORS TO THE IMPERIAL RUSSIAN COURT
Ste Pierre Smirnoff
90.4 PROOF

SMIRNOFF SILVER® VODKA. 90.4 PROOF. DIST. FROM GRAIN. STE. PIERRE SMIRNOFF FLS. (DIV. OF HEUBLEIN.) ©1973, HEUBLEIN, INC., HARTFORD, CONN

The Silver Martini.
For people who want a silver lining without the cloud.

Smirnoff Silver. Ninety point four proof. Smirnoff leaves you breathless®

Our goal was to make getting there as much fun as being there.

When we designed our GMC MotorHome, we had something quite special in mind. We wanted a motorhome that would actually be fun to drive.

Which is why a GMC MotorHome looks the way it does. Aerodynamic. And low—lower than any other motorhome. So it can handle crosswinds. And corners.

That's also why we've provided it with front-wheel drive, a 455-cubic-inch V-8 with automatic transmission, and tandem rear wheels with air suspension. So it can handle highway speeds. And off-highway bumps.

Not that we've ignored living comfort. In fact, 15 floor plans, in four different color-coordinated decors, are available.

If you want specifics, send for our 28-page color catalog. Simply write: GMC MotorHome Headquarters, Drawer Y, Dept. 307, Lansing, Mich. 48909.

Better yet, see your local GMC MotorHome dealer.

The GMC MotorHome. It doesn't look like a box. It doesn't ride like a truck.

GMC

The MotorHome from General Motors.

1055-CR
GM
MARK OF EXCELLENCE

NATURAL HISTORY

MAY 1974 · $1

Collect signed works of art by Waterford.®

Hold Waterford to the light and you can see faintly etched the signature that identifies it as an authentic work of art.

Each piece of Waterford crystal is a signed original, made by hand with heart. Born in white hot heat, its sheer brilliance reflects the glory of the distant past.

Every single facet is cut by hand in Ireland, just the way Waterford museum pieces were cut long years ago.

Waterford gathers the light of ten thousand yesterdays to illuminate ten thousand tomorrows.

It is an investment in art that will enchant you now; and reward you and your heirs as it grows in value.

To illustrate two current works of art: Decanter, $55.25, Vase 6," $27.50.

Write for free full-color booklets. Waterford, 225 Fifth Ave., New York 10010.

Or visit the Waterford Gallery at the important store in your area.

Isn't it time you started collecting signed originals by Waterford?

(And English bone china by Aynsley, to go with it?)

Photo Pesin

NATURAL HISTORY

Incorporating Nature Magazine
Vol. LXXXIII, No. 5
May 1974

The American Museum of Natural History
Gardner D. Stout, President
Thomas D. Nicholson, Director

2 Authors

6 Letters

10 The Human Strategy: Potlatch Politics and Kings' Castles
Marvin Harris
The price of power and prestige is hard work.

20 Bios: Which End Is Up?
Arthur W. Galston
Seeds have their own way of answering that vital question.

24 This View of Life: Racist Arguments and I.Q.
Stephen Jay Gould
"It is just as likely that blacks have a genetic advantage over whites. And, either way, it doesn't matter a damn."

30 Birth of a Harbor Seal
Peter M. Knudtson
Sex life of a seal at sea has different rules.

38 Season of the Apple
Patricia W. Spencer
The 50,000 or more blossoms on one tree in the spring may lead to 30 bushels of apples in the fall.

46 Precarious Odyssey of an Unconquered Parasite
Kenneth S. Warren
An inch-long worm is man's worst enemy in the tropics.

54 Toward Infallible Earthquake Prediction
Christopher H. Scholz
Scientists now are worried about what will happen when they can actually tell people an earthquake is weeks away.

60 Life in the Camel's Shadow
Text and photographs: William Torry
Along the dry and rugged border between Kenya and Ethiopia, the camel is a nasty but necessary companion for humans.

70 A Matter of Taste: A Morel Tale
Raymond Sokolov

74 Sky Reporter: The Quasar Controversy
Robert Jastrow

78 Celestial Events
Thomas D. Nicholson

80 "What Did You Say?"
A review by Brian Sutton-Smith
Word games can be serious.

94 Additional Reading

96 Announcements

Cover: Morchella angusticeps *is one of fifteen species of morels, which are considered the choicest of all the edible fungi. Photograph by Joy Spurr, Bruce Coleman, Inc. Story on page 70.*

Alan Ternes, Editor
Thomas Page, Designer
Board of Editors:
Sally Lindsay, Frederick Hartmann,
Christopher Hallowell, Toni Gerber
Carol Breslin, Book Reviews Editor
Florence G. Edelstein, Copy Chief
Karen Bierstedt, Copy Editor
Angela Soccodato, Art Asst.
Diane Pierson, Editorial Asst.
Lillian Gindea
Joyce E. Klutch

Rosamond W. Dana, Publications Editor

Editorial Advisers:
Dean Amadon, Dorothy E. Bliss,
Mark Chartrand, Niles Eldredge,
Vincent Manson, Margaret Mead,
Thomas D. Nicholson, Gerard Piel,
Richard G. Van Gelder

David D. Ryus, Publisher
L. Thomas Kelly, Business Manager
Ernestine Weindorf, Administrative Asst.

Robert E. Williamson, Production Manager

Ann Brown, Circulation Manager
Joan Mahoney
Harriet Walsh

Harvey Oshinsky, Advertising Sales Manager
Gordon Finley
Harry R. Jeter
Vic Asselin
Eileen O'Keefe, Production
Cynthia Dawson, Asst.

Publication Office: The American Museum of Natural History, Central Park West at 79th Street, New York, N.Y. 10024. Published monthly, October through May; bimonthly June to September. Subscriptions: $8.00 a year. In Canada and all other countries: $10.00 a year. Single copies $1.00. Second-class postage paid at New York, N.Y., and at additional offices. *Copyright © 1974 by The American Museum of Natural History. No part of this periodical may be reproduced without the written consent of* Natural History. *Manuscripts and illustrations submitted to the editorial office will be handled with all possible care, but we cannot assume responsibility for their safety. The opinions expressed by authors are their own and do not necessarily reflect the policy of The American Museum.* Natural History *incorporating* Nature Magazine *is indexed in* Reader's Guide to Periodical Literature.

Change of address notices, undeliverable copies, orders for subscriptions, and other mail items are to be sent to Natural History Magazine, Membership Services, Box 6000, Des Moines, Iowa 50306.

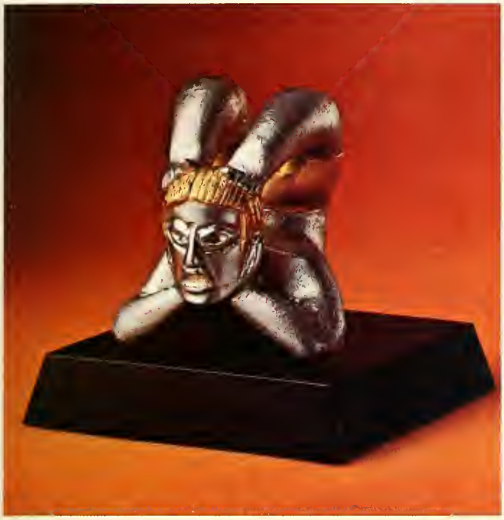
Authors

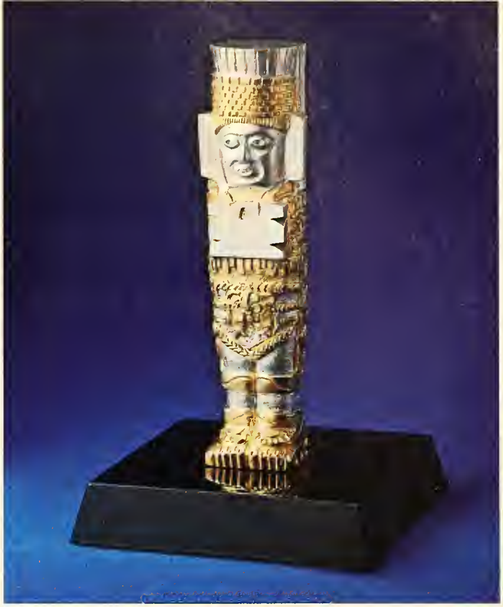
"I've been analyzing dying leaves for so long," says **Patricia W. Spencer**, "that I wanted to write about the other end of the nitrogen cycle—the growing fruit." Thus she began to observe the apples in the variety plot at the University of Illinois, where she has been assistant horticulturist for eight years. Still primarily interested in leaf senescence, which she described in "The Turning of the Leaves" (*Natural History*, October, 1973), Spencer has been studying leaf ultrastructure, enzymes, and nitrogen transport mechanisms to determine the sequence of biochemical and physical changes in dying leaves.

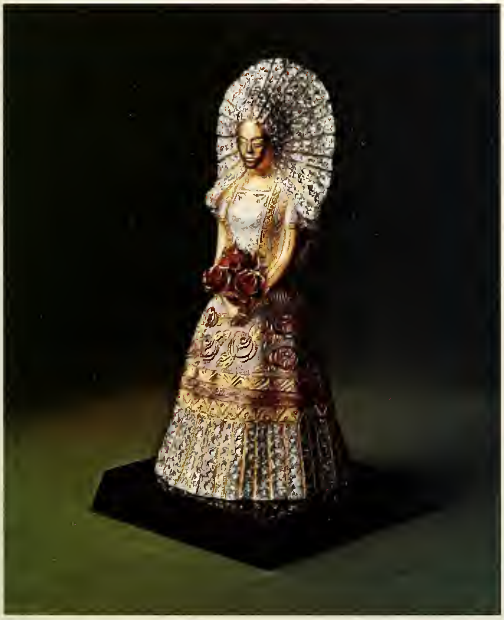
The accessibility of the harbor seal rookery in Humboldt Bay, California, provided an ideal opportunity for **Peter M. Knudtson** to study the animals as part of his master's degree program in biology at Humboldt State University. To learn the social mechanisms by which these seals successfully adapt to their environment and raise their young, Knudtson focused his research on the interactions of mothers and pups. With his graduate work completed, Knudtson now plans to investigate the social behavior and natural history of other marine mammals, while pursuing a career as a free-lance nature writer and photographer.

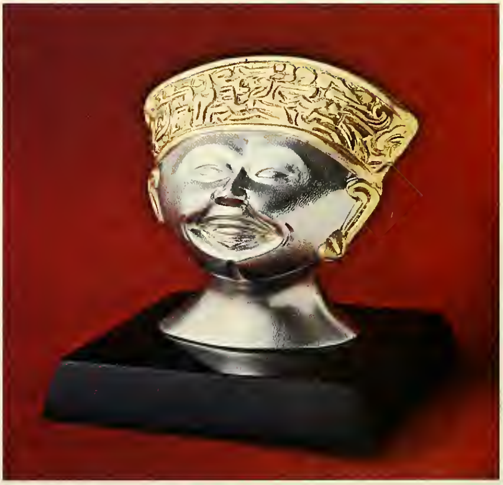
When he enrolled at Harvard Medical School, **Kenneth S. Warren** turned to tropical medicine because it was a relatively unstudied field and also allowed him to fulfill a desire for travel. He lived in Brazil for a year doing research on schistosomiasis, and for five consecutive summers he worked with a Rockefeller Foundation medical team on the Caribbean island of St. Lucia. This summer and for the next two summers, Warren plans to study the disease in Kenya. During the academic year, he teaches tropical medicine and library sciences at Case Western Reserve School of Medicine in Cleveland, Ohio.

The Mexican Collection









(top left) **Acrobat of Tlatilco.**
Scale replica 2⅞" high including base. Numbered Issue of 1000, $265.

(top right) **Atlante from Tula.**
Scale replica 4⅝" high including base. Numbered Issue of 1000, $225.

(lower left) **Tehuana Lady** in Fiesta Costume. Contemporary/Folkloric/ 8⅝" high including base. Numbered Issue of 300, $1750.

(lower right) **Smiling Face.**
Scale replica 3¼" high including base. Numbered Issue of 1000, $225.

Brielle China & Galleries

Brielle China and Galleries is proud to be selected by LUNT GALLERIES as the first dealer in the United States to display a selection of famous Mexican art forms in precious metals. The first group of Numbered Issues, produced under the authorization of the National Museum of Anthropology and History in Mexico City, is meticulously and painstakingly crafted to scale, from the originals displayed in the Museum. Each piece is superbly detailed in sterling silver and 22 karat gold electroplate, with a protective coating of rhodium plate to prevent tarnishing.

A colorful brochure describing twelve Numbered Issues is available for $1.
Visit our Collector's Gallery. Brielle China and Galleries, in Brielle, N.J. 08730. (201) 223-3626.

It's as easy to live with on the road as it is standing still.

Which is why a GMC MotorHome looks the way it does. Aerodynamic. And low—lower than any other motorhome. So it can handle crosswinds. And corners.

That's also why we've provided it with front-wheel drive, a 455-cubic-inch V-8 with automatic transmission, and tandem rear wheels with air suspension. So it can handle highway speeds. And off-highway bumps.

Not that we've ignored living comfort. In fact, 15 floor plans, in four different color-coordinated decors, are available.

If you want specifics, send for our 28-page color catalog. Simply write: GMC MotorHome Headquarters, Drawer Y, Dept. 307 Lansing, Mich. 48909.

Better yet, see your local GMC MotorHome dealer.

The GMC MotorHome. It doesn't look like a box. It doesn't ride like a truck.

GMC

The MotorHome from General Motors.

GM
MARK OF EXCELLENCE
GMC
444N52

The first earthquake **Christopher H. Scholz** remembers took place in 1952 when he was nine years old. It didn't get into the record book, but it did shake his family's house in Tehachapi, in southern California. Scholz has been interested in the mechanism and prediction of earthquakes ever since. Now a seismologist with a Ph.D. from M.I.T., he is a professor of geology at Columbia University in New York and a senior research associate at the university's Lamont-Doherty Geological Observatory. His current work involves laboratory research on rock fractures and friction and field studies of earthquakes, with a view to refining the theory of prediction he helped develop. This is Scholz's second appearance in these pages (*see* "New Zealand's Mountains: A Majestic Accident," February, 1974).

For more than three years, **William Torry** lived with the nomadic Gabra and Rendille tribes of Kenya and Ethiopia. To understand the role animals play in human affairs, he followed the tribes through arid regions as they tried to meet the water and food requirements of their camels, sheep, and goats. Torry's interest in the influence of animals on human organization was awakened by several summers spent working on ranches in the western United States and by the study of Navajo sheep husbandry. During his stay in Africa, he also did research on the influence of a limited food supply on cultural values and personality characteristics. A teacher of anthropology at the City University of New York, Torry is planning to return to East Africa to continue his investigations.

"*Escape from the Ordinary*"™

Norm Thompson Tyroleans

–Sport shorts designed by professional loafers Made better for us amateurs.

You see them on Alpine guides, professional hunters, people who direct leisure fun at summer resorts. Tyroleans are worn by professionals whose work is so much fun, *it seems like loafing.*

We've taken the good looking, functional European design. Added American comfort and easy care. Tailored them with double-stitched seams for durability— *kept the slim look* and *4 practical pockets* in front. (Men's shorts also have 2 rear pockets.)

Cut for action, Tyrolean shorts are comfortable when you move—comfortable when you're just relaxing. They look slim and trim all the time.

Tyroleans are also available in slack length, shipped unhemmed. Both are made of cool, lightweight Tundra cloth, 50% cotton, 50% dacron. Easy-care . . . just wash and wear 'em. Color: Tan. Men's even waist sizes: 28-44. Women's even sizes: 8-20. Shorts: **$12.00 ppd.** Slacks: **$14.00 ppd.**

Norm Thompson
Dept. NH-M
1805 N.W. Thurman
Portland, Or. 97209

Order (toll-free) anytime 800-547-6712

Tyroleans:	**Qty.**	**Size**		**Qty.**	**Size**
Men's shorts			slacks		
Women's shorts			slacks		

☐ Check enclosed. Charge to my:
☐ BankAmericard. ☐ MasterCharge.
(Please include all raised letters and numbers.)
Card #
Signature X

☐ Send FREE 40 page Spring & Summer color catalog. Save up to ⅓ on imported sports clothes and equipment.

Escape from the ordinary

Name
Address
City
State Zip

Letters

Singing to Corn

As a member of the professional scientific community, I would like to say that I feel that Peter Tompkins and Christopher Bird deserve a fairer review of their book than the blatantly pompous one rendered by Arthur W. Galston in your March issue (e.g., "I have an eighteen-volume encyclopedia on the subject of plant physiology in my office, as well as more than twenty-five textbooks and monographs"). Galston becomes so enraged by the book's lack of "hard-nosed procedures" that he fails to see that one of the major gleanings here is the fact that the very essence of this "hardness" has possibly kept us from seeing certain dimensions of plant life all along.

Without really going into an elaborate defense of alternative methods for gaining quite valid data, I would, for a beginning, call upon Galston to elaborate on the "hard-nosed procedures" used by the American Indians to discover the medicinal uses of plants. Vogel's classic work (*American Indian Medicine*) clearly points out that the American Indians used over 95 percent of the known indigenous vegetable drugs listed in *The United States Pharmacopoeia.* Furthermore, to assume that the American Indians merely went around eating every plant in sight to gain such knowledge over time would be a naïve assumption and contrary to current ethnographical data. It appears to me that Tompkins and Bird have provided the most parsimonious theory to explain this incredible feat on the part of the American Indians.

To me the real harm done by the book is merely the psychological guilt to which people like Galston could easily fall prey when told they should spend more time hugging trees in the forest rather than dissecting the trees' relatives in the laboratory. It is little wonder Galston sounds so outraged, since the very foundations of his ethics are being infringed upon. However, I don't think we should get lost in all the pain, guilt, and trauma of the situation, but rather we should be delightfully refreshed by the mere possibility of some of the contentions put forth by Tompkins and Bird. Anyway, I never did think a Hopi Indian walked thirty miles a day in the desert to sing to his corn for nothing.

William S. Lyon, Ph.D.
Sociology-Anthropology Dept.
Southern Oregon College

Bravo! Thank you so much for publishing the wonderful book review by Dr. Arthur W. Galston. Almost any book on currently popular topics will be published, and especially in matters of science, the public is very often led far away from the "truth" as most reputable scientists see it. You have done a service to the consumer by printing a review that points out so well the many shortcomings of this book, in particular, and which can be extended to include all such books, too many of which have already been published (especially in the fields of health and psychology).

Susan Torre-Bueno
The Rockefeller University
New York, New York

Henson's Greatness

If writer-photographer Fred Bruemmer, author of "The Northernmost People" [February, 1974], knew more about Matthew Henson he would not dismiss him as Admiral Peary's black servant.

Henson was with Peary on every attempt made for the North Pole. Henson served as his "black servant" for perhaps a month and as his companion and friend for more than twenty years. Surely in this day and age he can receive his due although we were unable to accept his accomplishments when he was living.

In the introduction to *Dark Companion*, by Bradley Robinson, Comdr. Donald B. MacMillan quotes Peary as saying, "Henson is not to return [i.e., go back]. I can't get along without him." And to quote MacMillan: "Matthew Henson went to the Pole with Peary because he was a better man than any one of us." That is hardly a sentence to be used for a "black servant."

The book goes on to explain Henson's greatness and his contributions to the discovery of the North Pole.

Beverly Belanger
Oakland, California

(Continued on page 9)

You can take pictures or you can *make* pictures

Whether or not you're traveling less these days,* you probably know better than some that in a backyard, in a nearby park, just off a familiar path, there is plenty to see and appreciate. Somehow a camera in front of your eye forces you to take the trouble to see the beauty just right.

The result helps fit it all into place, and it needn't be stowed away for just an occasional showing. Big prints in color bring in the real world to make the place where you live beautiful. The satisfaction of making them yourself can add considerably to the pleasure.

For a start in that direction, send a self-addressed envelope prominently marked "A3-75" to Kodak, Dept. 55S, Rochester, N.Y. 14650. We'll send you a guide to Kodak literature for all levels of photographic experience. Or a photo retailer can recommend a photo lab with a reputation for quality in color prints of generous size.

Kodak

---

*At Spokane, Washington this summer, we are at Expo '74 to preach the doctrine "Know the land and the people" with few words and such imagery as above. Public transportation is available from far and near. It's a World's Fair with pavilions from other nations, entertainment, and celebration of the natural environment.

American conductors are a rare breed -especially in America.

In the culture-conscious United States, there is a surprisingly small number of American symphony conductors.

Exxon is trying to help. We're sponsoring the Exxon-Affiliate Artists Conductor program. This program is designed to accelerate the careers of young American conductors, and, at the same time, expose more Americans to fine symphonic music.

The program has already placed six young conductors in residence with the Atlanta Symphony, the San Diego Symphony, the St. Paul Chamber Orchestra, the Pittsburgh Symphony, the National Symphony in Washington, D.C., and the Milwaukee Symphony. They're getting invaluable experience working closely with ranking conductors for a full season.

These young conductors are handling rehearsals. And they're conducting "outreach" concerts for special audiences—in parks and schools for youngsters, in homes for the aged, and in other institutions where the audiences are often unfamiliar with classical music.

They're also working with smaller musical groups in areas around their orchestra's home city. Because one of the aims of the program is to build public support for classical music and symphony orchestras.

And most important to them, these young maestros are conducting the full orchestras in regularly scheduled concerts several times during the season.

We hope Exxon with Affiliate Artists, Inc.
will bring many hours of musical
pleasure to American audiences.
By American conductors.

EXXON

We'd like you to know

Energy Orgy

Kenneth Watt's attribution to the United States of a unique profligacy in the use of energy ["The End of an Energy Orgy," February, 1974] and his comparisons with energy usage by other countries (especially, Switzerland and Japan) at specific, noncoincident times are quite misleading. Examination of trends in the data published by the Organization of Economic Cooperation and Development (OECD) for North America, Japan, and the nineteen OECD member countries of Europe portrays a different picture and points to a different lesson.

The total use of energy (Btus per year) by North America, mainly the United States, has, over the last fourteen years, been about 50 percent more than that of OECD Europe, and it is now about ten times that of Japan. But energy usage in both Europe and North America is increasing at the same rate: it has been doubling every twelve to fifteen years, and this rate of increase shows no sign of slackening for either region. Japan's energy usage is increasing much faster; it doubles every seven years. If the trends of the past fifteen years continue, Japan will use as much total energy per year as OECD Europe by about 1985; as much as North America by about the turn of the century.

These statistics all point in a single direction: exponentially increasing use of energy accompanies increasing industrialization. Within this trend, resource use patterns vary, but nowhere do they reflect an urge toward conservation of the scarcest major energy resource—oil. Thus the United States is not the unique energy wastrel that Watt portrayed. The entire industrialized world must develop new energy resources or change its life-style, and both will probably happen.

S. J. Deitchman
Chevy Chase, Maryland

Strong Words

Maurice Strong's apocalyptic claptrap on "global imperative" [March, 1974] is opinion stated as fact, pessimistic extrapolation of dubious historical trends, contradictory goals derived from shallow philosophical considerations, megalomania masquerading as morality.

Wm. T. St. Clair
Berryville, Virginia

Mountain Building

Author Christopher H. Scholz ["New Zealand's Mountains," February, 1974] gives us a cameolike picture of New Zealand geology and invokes the plate-tectonic theory to derive a clear, convincing account of its origins. In order to account for New Zealand's geology Scholz utilizes a comparison between his Alpine fault and the famous San Andreas fault of California. This comparison works out very well; indeed, it works out better than the author apparently realizes. He states: "The idea that the Southern Alps have been uplifted on the Alpine fault . . . is attractive because it would explain the steep western escarpment of the Alps and its close association with the Alpine fault. The bothersome question is why this should occur. A similar high mountain range has not developed next to the San Andreas fault in California."

In fact, the mechanism that Scholz proposes for the uplifting of the Southern Alps—the offset of one transform or strike-slip fault by another so that shearing motion is translated into local compression of adjacent plates—is just about identical to the accepted explanation for the origin of our San Gabriel Mountains. During the San Fernando earthquake of February, 1971, the San Gabriels increased in elevation (locally) as much as six feet; this is the fastest-growing mountain range in the world. The anomalous east–west trend of the San Gabriel Mountains, and of the entire Transverse Ranges is explained by the idea that the San Andreas fault is offset by a break that is probably related to the offshore Murray escarpment. Northwestward movement of the coastal plate is thus causing it to be rammed into the "Big Bend" in the San Andreas fault, with resulting compression, deformation, and uplifting of the Transverse Ranges.

Mark S. Newton
Los Angeles City College

Beautiful Photos

While George Rentz's informative article on Oman (March, 1974) was excellent and enriching, I hope he shares the credit with the photographer, Bruno Barbey, whose efforts rounded out the over-all presentation beautifully.

Peter Toll
Bandon, Oregon

Race Reconsidered

Steven Jay Gould's article on racial classification [March, 1974] was a clear statement about an important trend in the study of human biology: the understanding of human variation and not its classification. Unfortunately, the nonracial approach seldom impresses the public; hopefully, articles such as Gould's will help to get the message across.

Considering the thoughtful statements on the inadequacies of racial or subspecific classification, perhaps Gould should reconsider his statements on the nature of other taxonomic units. Is it a fact that "all organisms must belong to a species, each species must belong to a genus"? If race survives as a viable term, it should be used as it was originally, as an arbitrary device to aid in discussion. Might not the higher taxonomic categories be considered in the same light?

Richard G. Wilkinson
State University of New York
Albany, New York

No Trespassing

There is an idea among people, Americans and pioneer ethic types in particular, that individuals can own natural land—lakes, forests, and oceanfront property—"own" meaning the right to dispose of as one sees fit and to not grant outsiders access to it. That idea is totally out of keeping with nature and is evil. People must have access to natural areas. That is a right and a need dictated by man's evolution. That is a need that cannot always be satisfied.

I have actually gone 360 degrees around small lakes looking for access for scuba diving, only to find the entire circumference was privately owned and no trespassers were allowed. I have driven for miles on Cape Cod looking for a public beach; I have seen beach areas "close" at 10:00 P.M.; and I've been hit on the head by an oar-wielding lifeguard who said I was swimming out too far and that he had the authority to order me to shore. He didn't and I didn't return.

Beaches do not close, oceans do not close, and lifeguards cannot order me to do anything. It is my prerogative to decide my capabilities and wants and not anyone else's. It is my decision and my responsi-

(Continued on page 92)

Potlatch Politics and Kings' Castles

Hunting and gathering tribes have never made the leap into the struggle for power and prestige

Some of the most puzzling lifestyles on exhibit in the musuem of world ethnography bear the imprint of a drive for prestige. Many people seem to hunger for approval. Occasionally their craving becomes so powerful that they compete with each other for status as others compete for land, food, or sex. At times this competition is so fierce that it becomes an obsession, wholly divorced from, and even directly opposed to, material costs.

Americans spend their entire lives trying to climb further up the social pyramid in order to impress each other. We seem to be more interested in being admired for the wealth we accumulate than in the actual wealth itself, which often consists of chromium baubles or other useless objects. Thorstein Veblen's mordant phrases "conspicuous consumption" and "conspicuous waste" convey a sense of the intense desire to "keep up with the Joneses" that lies behind the ceaseless cosmetic alterations in the automotive, appliance, and clothing industries.

Early in the present century, anthropologists were surprised to discover that certain "primitive" tribes engaged in conspicuous consumption and conspicuous waste to a degree unmatched by the most wasteful of modern consumer economies. Ambitious, status-hungry men competed with each other by giving huge feasts and judged each other by the amount of food that was provided. A feast was a success only if the guests ate until they were stupefied, staggered into the bush, vomited, and came back for more.

The most bizarre instance of status seeking was discovered among the American Indians who formerly inhabited the Pacific Northwest. Here the chiefs practiced *potlatch*; their object was to give away or destroy more wealth than their rivals. In an attempt to shame his rivals and gain everlasting admiration from his followers, a powerful chief might destroy food, clothing, money, and sometimes, even burn down his own house.

Potlatch was made famous by Ruth Benedict in her book *Patterns of Culture,* which describes how the custom operated among the Kwakiutl, the aboriginal inhabitants of Vancouver Island. Benedict thought that potlatch was part of a megalomaniacal life-style characteristic of the Kwakiutl. Ever since, potlatch has been a monument to the belief that cultures are the creations of inscrutable forces and deranged personalities.

But the Kwakiutl potlatch was not the result of maniacal whims; it was caused by definite economic and ecological conditions. In the absence of these conditions, the need to be admired and the drive for prestige express themselves in completely different ways. Inconspicuous consumption replaces conspicuous consumption; conspicuous waste is forbidden; and there are no competitive status seekers.

The Kwakiutl lived in villages close to the shore. They fished and hunted along the island-studded sounds and fjords in dugout canoes.

At the beginning of a potlatch, guests are entertained by dancers wearing beaver god and thunderbird masks.

Copyright © 1974 by Marvin Harris. From Cows, Pigs—Wars & Witches—*to be published by Random House, Inc.*

by Marvin Harris

AMNH

Eager to attract traders, they made their villages conspicuous by erecting on the beach the carved tree trunks we erroneously call "totem poles." The carvings on these poles symbolized the ancestral titles to which the village chiefs laid claim.

A Kwakiutl chief was never content with the degree of respect he received from his followers and from neighboring chiefs. Always insecure about his status, each chief felt the obligation to justify and validate his chiefly pretensions. The prescribed manner for doing this was through a potlatch, which was given by a host chief and his followers to a guest chief and his followers. The object was to show that the host chief was truly entitled to chiefly status and was more exalted than the guest chief. To prove this point, the host chief gave his guests quantities of valuable gifts. The guests, in turn, would belittle what they received and vow to hold a return potlatch at which their chief would prove that he was greater than the present host by giving even larger quantities of more valuable gifts.

Preparations for a potlatch required the accumulation of fresh and dried fish, fish oil, berries, animal skins, blankets, and other valuables. On the appointed day, the guests paddled up to the host village in their dugout canoes and went into the chief's house. There they gorged themselves while dancers, masked as beaver gods and thunderbirds, entertained them.

The host chief and his followers neatly piled up the wealth that was to be given away. As the host pranced up and down, boasting about how much he was about to give them, the visitors stared sullenly. Counting out the boxes of fish oil, baskets of berries, and piles of blankets, the host commented derisively on the poverty of his rivals. Laden with gifts, the guests finally returned to their village, where, stung to the quick, the guest chief vowed to get even. This could only be achieved by holding a return potlatch and obliging his rivals to accept even more valuables than they had given away. Considering all the Kwakiutl villages as a single unit, potlatch stimulated a ceaseless flow of prestige and valuables moving in opposite directions.

An ambitious chief and his followers had potlatch rivals in several different villages at once. Specialists in counting property kept track of what each village had to do to even the score. If a chief managed to best his rivals in one place, he still had to confront them in another.

At some potlatches, valuables were not given away but were destroyed. Successful potlatch chiefs sometimes decided to hold "grease feasts" at which boxes of candlefish oil were poured on the fire in the center of the house. As the flames roared, the guests sat impassively or even complained about the chill in the air. At some grease feasts the flames ignited the roof, and the entire house would become a potlatch offering, causing the greatest shame to the guests and much rejoicing among the hosts.

According to Ruth Benedict, potlatching was a result of the obsessive status hunger of the Kwakiutl chiefs. "Judged by the standards of other cultures the speeches of their chiefs are unabashed megalomania," she wrote. "The object of all Kwakiutl enterprises was to show oneself superior to one's rivals." In her opinion, the whole aboriginal economic system of the Pacific Northwest was "bent to the service of this obsession."

I think that Benedict was mistaken. The economic system of the Kwakiutl was not bent to the service of status rivalry; rather, status rivalry was bent to the service of the economic system.

All of the basic ingredients of the Kwakiutl giveaways, except for their destructive aspects, are present in other societies dispersed over different parts of the globe. Stripped down to its elementary core, the potlatch is a competitive feast, a nearly universal mechanism for assuring the production and distribution of wealth among peoples who have not yet fully acquired a ruling class.

Melanesia and New Guinea present the best opportunity to study competitive feasting under relatively pristine conditions. Throughout this region, so-called big men owe their superior status to the large number of feasts that each has sponsored. Each feast is preceded by an intensive effort by an aspiring big man to accumulate the necessary wealth.

Among the Kaoka-speaking people of the Solomon Islands, the status-hungry individual begins his career by making his wife and children plant larger yam gardens. As described by the Australian anthropologist Ian Hogbin, the aspiring big man then has his kinsmen and age-mates help him fish. Later he begs sows from his friends to increase his pig herd. As the litters are born, he boards additional animals with his neighbors. Soon his relatives and friends feel that the young man is going to be a success; seeing his gardens and pig herd, they redouble their work efforts. When he does become a big man, they want him to remember that they helped him.

Finally, they all build a fine house in which, as in the case of potlatch, the wealth is stacked in neat piles and displayed for the guests to count and admire.

At one feast given by a young man named Atana, Hogbin counted 250 pounds of dried fish, 3,000 yam and coconut cakes, 11 large bowls of yam pudding, and 8 pigs. In this instance, some of the guests themselves brought presents to be added to the giveaway. Their contributions raised the total to 300 pounds of fish, 5,000 cakes, 19 bowls of pudding, and 13 pigs.

Atana proceeded to divide this wealth into 257 portions, one for everyone who had helped him or who had brought gifts, rewarding some more than others. "Only the remnants were left for Atana himself," notes Hogbin. Status seekers in Guadalcanal always say: "The giver of the feast takes the bones and the stale cakes; the meat and the fat go to the others."

The feast-giving days of the big man, like those of the potlatch chiefs, are never over. On threat of being reduced to the status of a commoner, each big man prepares for the next feast. Since there are several big men per village and community, these plans and preparations often lead to complex competitive maneuvering for the allegiance of relatives and neighbors.

The big men work harder, worry more, and consume less than anybody else. Prestige is their only reward. They may be megolomaniacal, but they render an important service to society by increasing production. As a result of the big man's craving for status, more people work to produce more food and other valuables.

Under conditions where every-

Experts agree.

Jerry Fisher and Bobby Colomby of Blood, Sweat & Tears are tops in the rock and jazz world. Walt "Clyde" Frazier epitomizes the mastery of man over basketball. Innovator Andy Warhol has created a new wave in the field of cinema and art. Metropolitan Opera Orchestra conductor Henry Lewis has been acclaimed as "the most gifted American of his generation."

In a world of constantly changing values, this diverse group of super personalities still insists on perfection. That's why they all selected Pioneer high fidelity components.

Each has his own reason for involving himself in high fidelity. But they all agree on one thing. Pioneer is the very best. Pioneer consistently reproduces the most natural sound in music.

Whatever your interest in high fidelity — stereo or 4-channel — Pioneer makes it best. Depending on the degree of sophistication you want, there's something to fit every budget.

Yet, there's one fact you can always be sure of. No matter what you spend for Pioneer you get the same top quality as Jerry, Bobby, Walt, Andy and Henry.

Experts agree on Pioneer.
So will you.

U.S. Pioneer Electronics Corp.
75 Oxford Drive, Moonachie
New Jersey 07074
West: 13300 S. Estrella, Los Angeles
90248/Midwest: 1500 Greenleaf, Elk
Grove Village, Ill. 60007 / Canada:
S. H. Parker Co.

PIONEER
when you want something better

Shown above are Pioneer's magnificent 4 Channel Receivers and three great Pioneer Speaker Systems R-700, CS-99A and Project 100.

one has equal access to the means of subsistence, competitive feasting serves the function of preventing the labor force from falling back to levels of productivity that offer no safety margin in crises such as war and crop failures. In the absence of formal political institutions that can integrate independent villages into a common economic framework, competitive feasting creates a network of intervillage economic expectations. It promotes the sharing of food and resources among people who live in different villages. Finally, competitive feasting by big men acts as an equalizer of annual fluctuations in productivity among villages occupying different microenvironments—seacoast, lagoon, or upland habitats. Automatically, the biggest feasts in any given year will be given by villages that have enjoyed conditions favorable to production.

All of these points applied to the Kwakiutl. The Kwakiutl chiefs were like Melanesian big men except that they operated with a much more productive technology in a richer environment. Like big men, they competed with each other to attract men and women to their villages. The greatest chiefs were the best providers and gave the biggest potlatches. The chief's followers shared vicariously in his prestige and helped him to achieve more exalted honors. The totem poles were grandiose advertisements proclaiming that a village had a mighty chief.

Thus, despite the overt competitive thrust of potlatch, it functioned to transfer food and other valuables from centers of high productivity to less fortunate villages. Since fish runs, wild fruit, and vegetable harvests fluctuated unpredictably, intervillage potlatching was advantageous from the standpoint of the regional population as a whole. When the fish spawned in nearby streams and the berries ripened close at hand, last year's guests became this year's hosts. To eat, all a poor village had to do was admit that the rival chief was a great man.

Why did the practical basis of potlatch escape the attention of Ruth Benedict? Anthropologists began to study potlatch only after the Pacific Northwest aborigines had entered into commercial and wage-labor relations with Russian, English, Canadian, and American merchants and settlers. This contact gave rise to epidemics of smallpox and other European diseases that killed off a large part of the native population. The Kwakiutl population fell from 23,000 in 1836 to 2,000 in 1886, a decline that intensified the competition for manpower.

At the same time, wages paid by the Europeans pumped unprecedented amounts of wealth into the potlatch network. The Kwakiutl received thousands of blankets from the Hudson's Bay Company in exchange for animal skins. These blankets replaced food as the most important item given away at the great potlatches. The dwindling population soon found itself with more valuables than it could consume. Yet the need to attract followers was greater than ever due to the labor shortage. So the potlatch chiefs ordered the destruction of property in the vain hope that such spectacular demonstrations of wealth would bring the people back to the empty villages. But these were the practices of a dying culture struggling to adapt to a new set of political and economic conditions; they bore little resemblance to the potlatch of aboriginal times.

To the participants, competitive feasting is a manifestation of an insatiable craving for prestige. But from the point of view outlined in this article the insatiable craving for prestige is a manifestation of competitive feasting. Every society makes use of the need for approval, but not every society links prestige to success in competitive feasting.

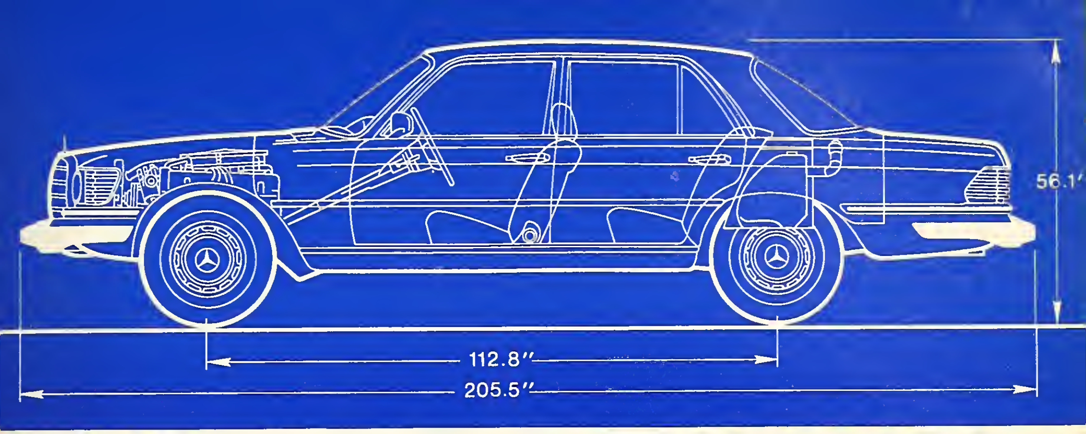
Competitive feasting as a source of prestige must be seen in evolutionary perspective to be properly understood. Big men like Atana or the Kwakiutl chiefs carry out a form of economic exchange known as redistribution. That is, they gather together the results of the productive effort of many individuals and then redistribute the aggregated wealth in different quantities to a different set of people. As I have said, the Kaoka big man works harder, worries more, and consumes less than anybody else in the village. This was not true of the Kwakiutl chiefs, however. The great potlatch chiefs performed the entrepreneurial and managerial functions required for a big potlatch, but they left the hardest work to their followers. The greatest potlatch chiefs even had a few war captives working for them as slaves. The Kwakiutl chiefs had begun to reverse the Kaoka formula and were keeping some of the "meat and fat" for themselves, leaving most of the "bones and stale cakes" for their followers.

If we follow the evolutionary line leading from Atana, the impoverished big man, to the semihereditary Kwakiutl chiefs, we eventually find societies ruled by hereditary kings, who perform no industrial or agricultural labor and who keep the best of everything for themselves. Exalted divine-right rulers maintain their prestige by building conspicuous palaces, temples, and monuments; they validate their right to hereditary privileges, not by potlatch, but by force.

Reversing direction, we can go from kings to potlatch chiefs to big men, ending up with egalitarian societies in which competitive displays and conspicuous consumption by individuals disappear, and where anyone foolish enough to boast about his greatness is accused of witchcraft and is stoned to death.

In the truly egalitarian societies that have survived long enough to be studied by anthropologists, the mode of exchange known as reciprocity predominates. Reciprocity is the technical term for an economic exchange between two individuals in which neither specifies precisely what is expected in return or when they expect it. Attitudes of reciprocity are similar to those we take when we exchange goods or services with our close relatives or friends.

Everything about reciprocity is opposed to the precise counting and reckoning of one person's debts to another. In fact, the idea is to deny that anybody really owes anything. One can tell whether a life-style is based on reciprocity if people do not say thank you. In truly egalitarian societies, it is rude to be openly grateful for the receipt of material goods or services. The Semai of central Malaya never express gratitude for the meat that a hunter gives away in exactly equal portions to his companions. Robert Dentan, who has lived with the Semai, found that to say thank you was rude because it suggested that you were either calculating the size



Suddenly, everyone wants a car with sensible size, reasonable weight, good mileage and safety. The Mercedes-Benz.

For some automobile manufacturers, a car with all of these qualities is years away. Every Mercedes-Benz Sedan has them all right now.

Mercedes-Benz has engineered its products with efficiency in mind for decades.

Sensible size, reasonable weight

An example is the 450SE Sedan. It's smaller than America's best-selling sedan outside, but *inside,* big car room.

What about gasoline mileage? A 450SE gets better mileage than any domestic luxury sedan. A combination of reasons tells you why:

The 450SE has a unique engine. An overhead camshaft configuration, this V-8 is smaller than any domestic example. Its electronic fuel injection measures out fuel only as it's needed.

The engine has an easier job. The 450SE weighs nearly half a ton less than the lightest domestic luxury car. Its shape was developed in the wind tunnel to slice through the air with low air resistance.

A smaller, more efficient engine, reasonable weight and a low drag shape. The reasons why a Mercedes-Benz 450SE gets up to 25% better mileage than domestic luxury sedans.

Safety

The Mercedes-Benz 450SE Sedan combines over fifty separate and significant safety elements, all engineered to complement one another.

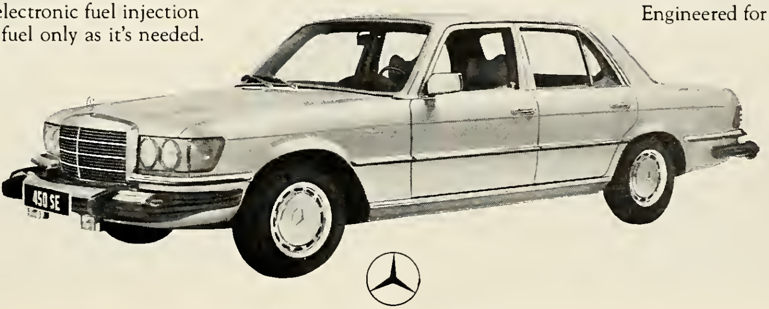
No other manufacturer makes safety a more important element in car design. The results of this commitment are to be found in every model Mercedes-Benz builds.

The best resale value in America

Advanced engineering and fuel economy. Two reasons why, after three years, Mercedes-Benz automobiles have a better resale value than any car made in America. And not just better—*the best.* Who says so? Leasing sources—and the automobile industry itself.

All of a sudden everyone wants design efficiency in an automobile. For that matter, these days everyone *needs* it. Mercedes-Benz has had it for years. Perhaps it's time you experienced it. Mercedes-Benz automobiles.

Engineered for today's needs.



Mercedes-Benz

of the piece of meat you had been given or that you were surprised by the success and generosity of the hunter.

In contrast to the conspicuous displays of Kaoka big men, the boasting of potlatch chiefs, and our own flaunting of status symbols, the Semai follow a life-style in which those who are most successful must be the least conspicuous. Status seeking through rivalrous redistribution, conspicuous consumption, or waste is unthinkable to them.

After Richard Lee of the University of Toronto had studied the Bushmen of the Kalahari Desert, he wanted to show his gratitude. As Christmas approached he learned that the Bushmen were likely to camp at the edge of the desert near villages where they sometimes obtained meat through trade. Intending to give them an ox for a Christmas present, he located a fat animal of monstrous proportions in a remote village. Returning to camp, Lee told the Bushmen one by one that he had bought the largest ox he had ever seen.

The first man to hear the news became alarmed. He asked Lee where he had bought the ox, what color it was, and what size its horns were, and then he shook his head. "I know that ox," he said. "Why, it is nothing but skin and bones!"

Lee confided in several other Bushmen, but continued to meet

AMNH

with the same reaction. When Christmas came the ox was slaughtered. It was covered with a thick layer of fat and was devoured with gusto.

Lee insisted upon an explanation. "Yes, of course we knew all along what the ox was really like," one hunter admitted. "But when a young man kills much meat he comes to think of himself as a chief or big man, and he thinks of the rest of us as his servants or inferiors. We cannot accept this." He went on. "We refuse one who boasts, for someday his pride will make him kill somebody. So we always speak of his meat as worthless. This way we cool his heart and make him gentle."

The Eskimo fear of generous gift givers is expressed by their proverb "Gifts make slaves just as whips make dogs." And that is exactly what happened. In evolutionary perspective, ambitious status seekers gave gifts that came from their own extra work: soon others found themselves working harder to reciprocate, which permitted the gift givers to give more gifts. Eventually the gift givers became so powerful that they disobeyed the rules of reciprocity. They could force people to pay taxes and to work for them without redistributing what was in their storehouses and palaces. Of course, as assorted modern big men and politicians sometimes recognize, "slaves" work better if given an occasional big feast instead of constant whippings.

If people like the Eskimo, Bushmen, and Semai understood the dangers of gift giving, why did others permit it to flourish? And why were big men permitted to get so puffed up that they could enslave the people whose work made their glory possible? Permit me to make a few suggestions.

Reciprocity is a form of economic exchange that is primarily adapted to conditions in which overproduction would have an ad-

A memorial tablet mounted in a Kwakiutl village in the early 1900s shows that Chief Clelemen had won fame and respect for his potlatches.

For over two centuries Americans have gathered round the Caswell-Massey bar

CASWELL-MASSEY
Oldest Chemists & Perfumers in America Est. 1752

—to sniff the wondrous variety of scents compounded by our master perfumers since 1752

1 CASMA
2 JOCKEY CLUB
3 NEWPORT
4 NUMBER 6
5 LIME
6 LEMONY LIME
7 TRICORN
8 VERBENA
9 PERSIAN LEATHER

Please use the numbers of the scents when filling in the coupon below

3 oz. $5.00, 8 oz. $10.00, 16 oz. $18.00, ½ gal. $65.00, 1 gal. $125.00
Toilet Water 4 oz. $11.00, 8 oz. $20.00, 16 oz. $37.50

CASWELL-MASSEY CO. LTD. ★ EST. 1752

★ AMERICA'S OLDEST ★ NEW YORK, N.Y. 10014

	COLOGNE WATER					TOILET WATER		
Size	3. oz. $5.00	8 oz. $10.00	16 oz. $18.00	½ gal. $65.00	1 gal. $125.00	4 oz. $11.00	8 oz. $20.00	16 oz. $37.50
Scents #								
Quantity								
Totals $								

use numbers above to indicate scents

Name:____________________
Address:____________________ NH574
____________________ Zip:__________

CHEMISTS & PERFUMERS ★ 320 W. 13th ST.

All major charge cards accepted. Kindly include charge number. Visit our historic pharmacy at 518 Lexington Ave. (48 St.) or send $1.00 for our unique catalog. Sorry, no C.O.D.

verse effect upon group survival. These conditions are found among certain hunters and gatherers, who, if they killed more animals and uprooted more plants than they needed, would risk permanent impairment of their food supply.

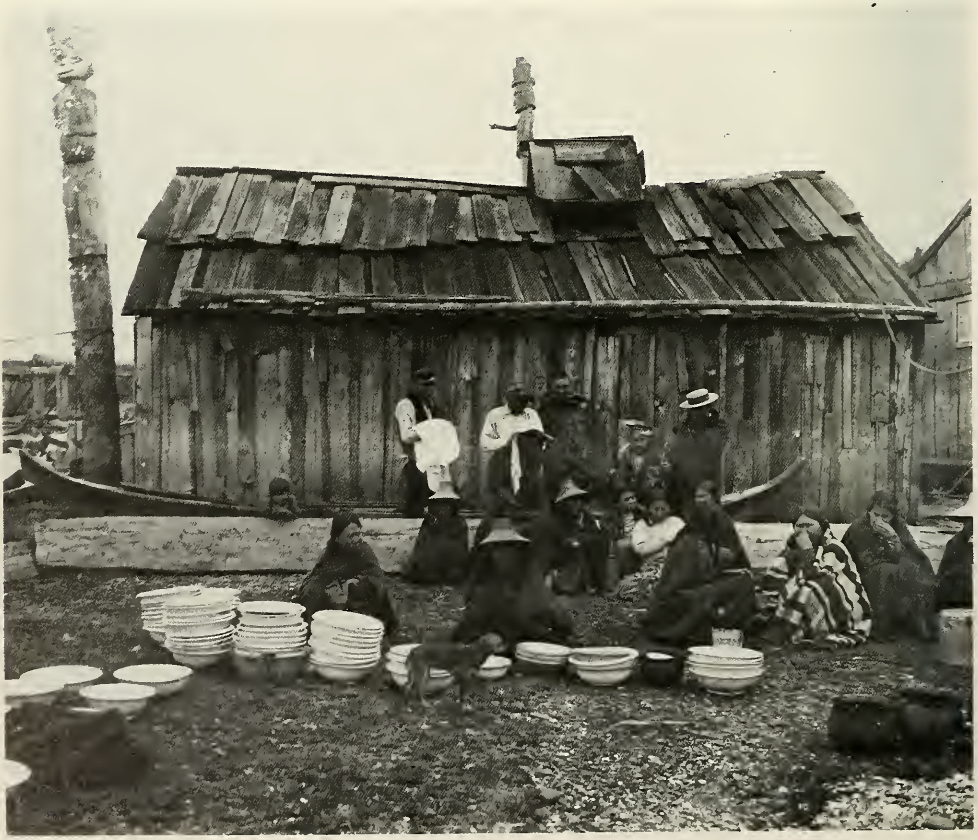
Lee found that the Bushmen worked for only ten to fifteen hours a week. "Primitive" hunters and gatherers work less than we do—without benefit of a single labor union—because their ecosystems cannot tolerate weeks and months of intensive extra effort. If an aspiring Bushman got his followers to work like the Kaoka for a month, every game animal for miles around would be killed or scared off and the people would starve to death.

Competitive feasting and other redistributive forms overwhelmed reciprocity when domesticated plants and animals were substituted for wild plants and animals. This raised the habitat's carrying capacity. Now the greater the effort, the more food produced. Prestige-hungry individuals could work harder and give away more to everyone's benefit. The only hitch was that this generosity had to be reciprocated. So people began to work harder in order to reciprocate the generosity of the few overzealous producers. As the reciprocal exchanges became unbalanced, they became gifts. As the gifts piled up, the gift givers were rewarded with prestige and counter gifts. Soon redistribution predominated over reciprocity, and prestige went to the most calculating gift givers, who shamed everybody into working harder than the Bushmen ever dreamed possible.

Conditions appropriate for the development of competitive feasting and redistribution sometimes also occurred among nonagricultural populations. Among the coastal peoples of the Pacific Northwest, annual runs of salmon, other migratory fish, and sea mammals provided the ecological analogue of agricultural harvests. The salmon or candlefish ran in such vast numbers that if the Kwakiutl worked harder, they would catch more fish. The main function of the potlatch, therefore, was not to award prestige, but to increase food production.

Stepping away for the moment from reciprocal and redistributive prestige systems, we can surmise

Kwakiutl women held their own potlatches. At Fort Rupert, British Columbia, women gather in front of the cooking and washing vessels that they will present to their guests.



AMNH

that every major type of political and economic system uses prestige in a distinctive manner. For example, with the appearance of capitalism in Western Europe, acquisition of wealth once more became the criterion for big-man status. Only in this case, the big men tried to take away each other's wealth, and highest prestige and power went to the individual who managed to accumulate and hold on to the greatest fortune. After they became secure, the capitalist upper class resorted to grand-scale conspicuous consumption and conspicuous waste in order to impress their rivals. They built mansions, adorned themselves with jewels, and spoke contemptuously of the impoverished masses.

Eventually, the rich were threatened by taxation aimed at redistributing their wealth. Conspicuous consumption in the grand manner became dangerous, so highest prestige now once again goes to those who have most but show least. With the upper class no longer flaunting its wealth, some of the pressure on the middle class to engage in conspicuous consumption has also been removed. This suggests to me that torn jeans and the rejection of overt consumerism among middle-class youth of late has more to do with aping upper-class trends than with any so-called cultural revolution.

One final point. You might wish to question the sanity of the process by which mankind was tricked into working harder in order to feed more people. The answer I see is that many primitive societies did refuse to expand their productive effort. But the fate of these peoples was sealed as soon as any one of them, no matter how remotely situated, crossed the threshold to redistribution and the full-scale stratification of classes that lay beyond. Virtually all of the reciprocity-type hunters and gatherers were destroyed or forced into remote areas by bigger and more powerful societies that maximized production and population. At bottom, this replacement was essentially a matter of the ability of larger, denser, and better-organized societies to defeat simple hunters and gatherers in armed conflict. It was either work hard or perish.

Columnist Marvin Harris teaches anthropology at Columbia University.

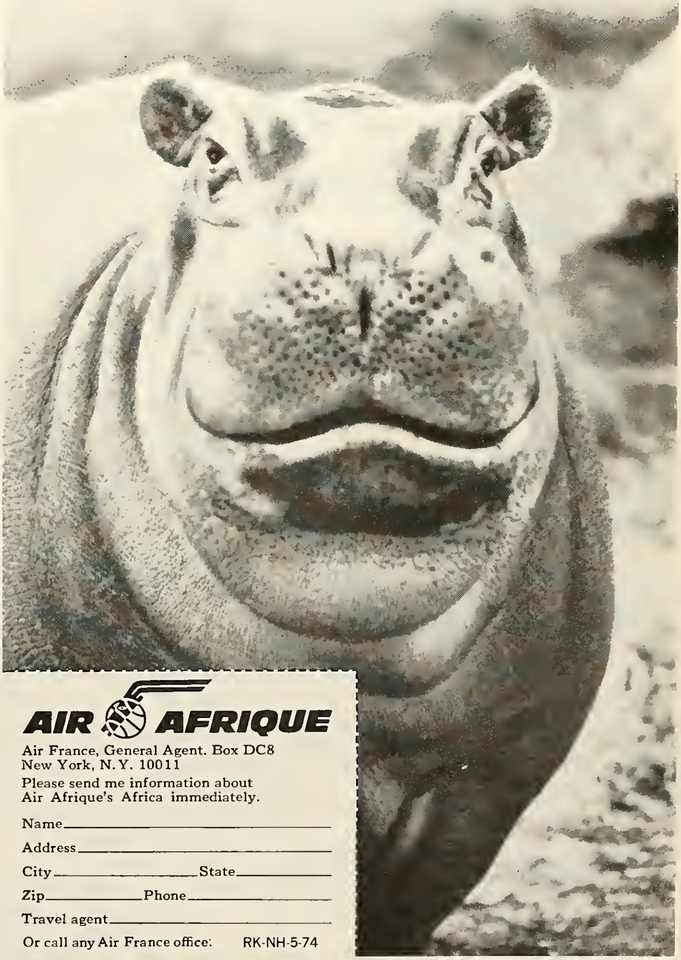
FLY THE AFRICAN EXPRESS.

It's New York to Dakar non-stop.
It's the greatest way to the last great continent.
It's Air Afrique. The African airline that knows Africa best.

Air Afrique's African Express jet adventures-off from Kennedy every Saturday at 6 P.M. Its destination: Dakar, and then on to Robertsfield/Monrovia, Abidjan, Lome, Douala, Libreville, and Kinshasa.

But Africa begins in the sky on Air Afrique. Our food is the finest African cuisine. Our stewardesses are dressed in magnificent native fabrics (one of Africa's finest arts). And our friendship is just a hint of what you'll find when you land.

Discover Africa. Our coupon can bring you closer. Our African Express can bring you there.



AIR AFRIQUE

Air France, General Agent. Box DC8
New York, N.Y. 10011
Please send me information about
Air Afrique's Africa immediately.

Name________________
Address________________
City________State________
Zip________Phone________
Travel agent________________
Or call any Air France office: RK-NH-5-74

Air Afrique's fleet now features DC-10's clean-powered by General Electric jet engines.

Which End Is Up?

Left to their own devices, plant roots and shoots grow in the right directions

When a farmer or a gardener throws a seed into the ground, he doesn't have to worry which end of the seed is up and which down. Whatever the orientation happens to be, and barring the unusual, the root will go down and the stem will come up. From a functional point of view, this is, of course, as it should be. The root is designed to anchor the plant and to absorb water and mineral nutrients for growth and development. To do these things, it must penetrate downward into the soil. The stem, on the other hand, is an axis for holding the maximum number of leaves in the best position to carry out the process of photosynthesis through light absorption. Obviously this activity has to be carried on above ground where the light is. But how does the plant distinguish up from down? What mechanism determines that the root will go down and the stem go up? These are complicated questions to which we have only partial answers despite a century of investigation.

If a germinated seedling is removed from the medium in which it has been growing and is laid on its side, the root will turn down, toward the center of the earth, and the stem will bend upward, away from the center of the earth. This curvature response is called geotropism. It is brought about by unequal rates of growth on the two sides of the cylindrical plant axis. In a horizontally placed seedling, the upper side of the root grows more than the lower side, and the resulting differential growth points the root tip down. The situation is reversed with the stem. When placed horizontally, the lower side of that organ grows more rapidly than the upper side, and the resultant growth curvature is therefore upward.

Seeds germinated in a satellite circling high above the earth, where the planet's gravitational field is very low, do not orient with their roots pointing down toward the center of the earth. This indicates that at least part of the reaction of seeds at the earth's surface is due to gravity. The gravitational stimulus, however, can be overcome by centrifugal force. Thus, if a plant is tied to the outer edge of a turntable that is spun with a force equivalent in the horizontal plane to the downward pull of gravity, the stem will grow partly inward instead of straight up, and the root partly outward instead of straight down. The root will, in effect, respond to a simple vectorial problem in which equal forces are exerted parallel and perpendicular to the earth's surface, and grow at an angle 45 degrees below the horizontal. As the centrifugal force of the rotating turntable is progressively increased, the angle of the root will approach the horizontal until the root is parallel to the turntable.

These facts suggest that the gravitational response of roots and stems might be due to the dislocation of a heavy body, or statolith, within plant cells, which can also be displaced by centrifuging. This is called the statolith theory. It presumes a mechanism similar to that by which animals balance themselves through the displacement of small calcium carbonate crystals in the semicircular canals of the ear. What could serve as a statolith in a plant cell? It appears that for the purpose of up–down orientation, plants employ very dense starch grains that fall to the bottom of specialized cells in response to gravity. If a root or stem is tipped 90 degrees, the heavy starch granules will roll from the bottom to another wall of the cell, thus indicating a new direction for the down–up axis. This theory is supported not only by direct microscopic observation of such falling starch grains but also by experiments in which removal of the granules from the specialized cells of the root cap makes the root insensitive to gravity. If, for example, the cap

In 3 seconds you'll know which electric portable to give for graduation.

Smith-Corona's new Cartridge Ribbon Typewriter.

It's the only one with the 3-second ribbon change.

Which is the quickest, simplest typewriter ribbon change there is. Also, the cleanest.

What's more, Coronamatic™ Ribbon Cartridges come in nylon and carbon film (the kind usually available only with expensive office typewriters).

So in the same 3 seconds it takes to change a cartridge, you can now change to carbon film for typing that looks like printing.

It's like having two typewriters in one. One for day-to-day use. The other for more professional-looking essays and reports.

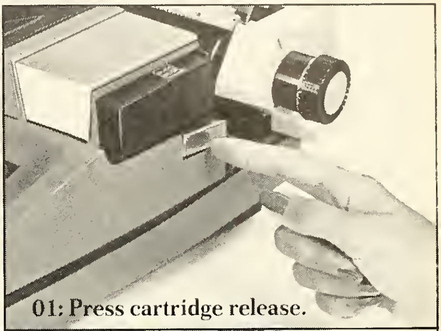
CORRECTION RIBBON

And in case there's a mistake, there's also a correction ribbon in a Coronamatic cartridge, so errors can be corrected in seconds.

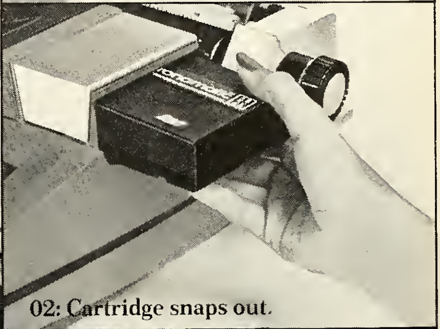
There's also an assortment of colors—so you can add a little (or a lot of) color to whatever is being typed.

Smith-Corona's new cartridge ribbon typewriters.

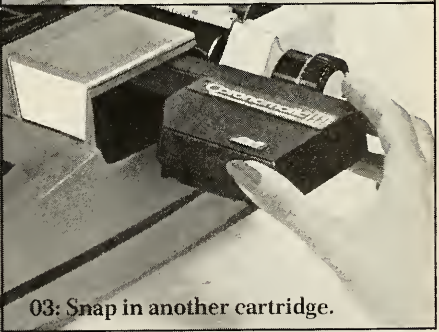
Because your graduate now has a lot more to think about than changing a typewriter ribbon.



01: Press cartridge release.



02: Cartridge snaps out.

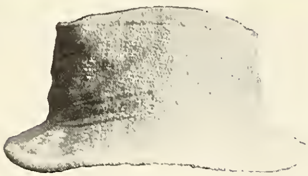


03: Snap in another cartridge.

SCM SMITH-CORONA
Coronamatic
Coronamatic

SCM® SMITH-CORONA
SCM CORPORATION

Talented Little Towel



Absorbent terry cloth towel is shaped into the Eddie Bauer Toweling Hat to outsmart summer heat two ways! When your brow is perspiring, just wipe it with your hat. Or douse your hat in water, wring it out and wear it to keep your cool at tennis, boating, fishing, camping or golf. Sizes: S(6¾-6⅞), M(7-7⅛), L(7¼-7⅜), XL(7½-7⅝). Colors: White, Yellow, Powder Blue, Navy. **2002** Toweling Hat, **$4.95** postpaid.

Order today! Money-back guarantee!

Enclosed is my check or money order for $________. (Add sales tax where applicable.)

Please rush my 2002 Toweling Hat.

Size__________Color__________

Name__________

Address__________

City__________

State__________Zip__________

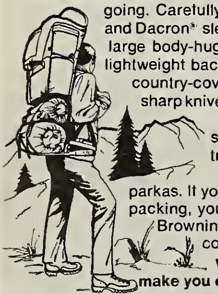
☐ Send me FREE your color catalog of over 1000 exciting outdoor products.

Eddie Bauer

Dept. KNH, 1737 Airport Way S., Seattle, Wa. 98124

You can smell the pines in this catalog.

The full-color Browning Catalog is filled with some of the finest back pack gear going. Carefully built Down and Dacron® sleeping bags, large body-hugging packs, lightweight backpack tents, country-covering boots, sharp knives, and really comfortable socks, shirts, trousers, and down-filled parkas. If you love backpacking, you gotta' have Browning. Send this coupon today! **We're out to make you comfortable.**



BROWNING

Sirs: Please send me a 120-page catalog. (Enclosed is 50¢ for postage.) Browning, Dept. C50, Morgan, Utah 84050. In Canada: Browning Arms Co. of Canada Ltd.

NAME

STREET

CITY STATE ZIP

is carefully removed from certain roots, the rate at which these roots grow is not affected, but the organs' ability to respond to gravity is lost and the roots will grow in whatever orientation they are placed. When the roots regenerate new caps containing visible statoliths, they regain their ability to curve geotropically. Although we cannot always see statoliths in geotropically sensitive cells, we reason by analogy that what is true in one system probably holds true for many systems.

How does the rubbing of the statolith against the cell wall create a disturbance in growth that results in geotropic curvature? The reaction is probably connected with an effect on the surface membrane of the cell's protoplasm, which presses against the cell wall. This effect, in turn, leads somehow to an altered transport of growth-promoting and growth-inhibiting substances. For example, a vertically oriented stem tip or root tip contains roughly equal quantities of growth-promoting and inhibitory hormones in its two lateral halves. But if a root tip is laid on its side, more growth hormones and growth inhibitors will be obtained from the lower than the upper side of the displaced tip. Since root growth is inhibited by the new, higher concentrations of hormone and inhibitor, we reason that the curvature is due to an inhibition of growth of the root's lower half relative to its upper half. With stems that have been horizontally placed, one also finds an accumulation of growth hormone on the lower side. But here, the higher concentration of hormone leads to a higher growth rate and thus to upward curvature of the stem.

Asymmetry in the distribution of growth-regulating substances is correlated with the development of a transverse electrical potential of up to 100 millivolts in a horizontally displaced organ. It used to be thought that this electric potential developed soon after statolith displacement and was the cause of the flow of negatively charged growth hormone toward the positively charged side of roots and stems. But recent experiments have shown that the reverse sequence of events is true; the negatively charged growth hormone is first displaced asymmetrically and then the transverse electrical potential arises. Undoubtedly the two phenomena are connected in an important, but unknown, way.

Putting everything together, our theory now reads as follows: Starch grains are displaced, stimulating the cell membrane; asymmetric distribution of growth regulatory substances and a transverse electrical potential follow; this leads to asymmetric growth and curvature.

While these simple facts provide an explanation of sorts about the positive geotropism of roots (toward the force of gravity) and the negative geotropism of stems (away from the force of gravity), they still leave many questions unanswered. For example, why does a stem grow in one direction and a root in another? The glib answer is that the growth regulator displacement leads to inhibition of root growth and promotion of stem growth. But quantitative investigations of the amounts of hormone displaced compared with the amount required to produce enough growth differences to lead to curvature tell us that this theory is probably not too accurate. That is why growth inhibitors are now surveyed as well. A second and more perplexing question is this: How can the rubbing of a starch grain against the cell membrane lead to lateral displacement of hormone and the appearance of bioelectric potentials? This may have to do with the movement of ions of hydrogen or a salt, since an electrical charge arises when a freely diffusible ion accumulates on one side of a differentially permeable membrane. But how can the rubbing of a starch grain lead to the movement of many millions of ions? The answer to this question remains unclear. Much work thus must still be done on the physiology of geotropism.

Not only stems and roots but also the petioles, or stalks, of leaves are sensitive to gravity and orient the leaf blade so it is roughly parallel to the earth's surface, and thus roughly perpendicular to the incoming solar radiation. When a potted plant is put on its side, its leaves reorient. This response, too, presumably involves the gravity perception of statoliths.

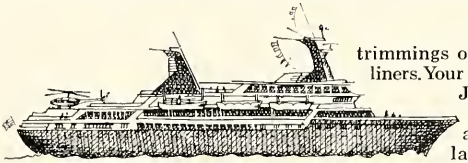
Even large tree trunks displaced from the vertical can right themselves in a most remarkable way by the formation of what is called "reaction wood." When a conifer stem is placed horizontally, the cell division activity of the cambium, the thin layer between wood and bark that produces new wood cells, becomes asymmetric; cells on the lower side of the stem will be much thicker walled and impregnated with much more of the woody substance lignin than cells on the upper side. This effect leads ultimately to a tremendous strain within the stem, which bends the trunk mechanically in a direction that tends to right it. Because they tend to press the stem upward, the heavy-walled cells on the lower part of the angled trunks of conifers are referred to as compression wood. Hardwood trees, on the other hand, give rise to a different kind of special cell on the upper part of a prostrate trunk. These cells are especially low in lignin and act as tension wood, in effect producing a gradient that again causes the rigid tree trunk to curve upward. Whether starch grains, hormones, and growth inhibitors are involved in this process, which can generate tremendous forces, is not really understood.

Some of the new growth regulatory chemicals that are used extensively in agriculture interfere with the transport of growth hormones in a stem. Thus, the hormone auxin normally moves only basipetally, that is, from the stem tip down to the root tip, and many plant growth reactions are the result of this unidirectional movement. But the application of a synthetic growth regulator such as triiodobenzoic acid, which is used to increase soybean yield, can interrupt the flow of auxin and cause it to accumulate in unexpected places. When this happens, tropistic responses are upset; some roots may be observed growing upward within the soil, and stems may curve and become parallel to the earth's surface or may actually turn downward. These abnormalities underscore the delicacy of the regulatory system of plants and emphasize the need for care in the use of such chemicals.

Plants can determine which end is up and which down, at least as long as we don't flood them with noxious chemicals or spin them too dizzily on a rotating wheel. But such treatment would probably cause humans to lose their sense of orientation too.

Columnist Arthur W. Galston teaches biology at Yale University.

Dare a little.
Soak up the midnight sun. Spy on a kittiwake, sail through Eskimo Country on the new M/V Bewa Discoverer.



It can happen this July. You can visit Viking discoveries. Fish waters swarming with salmon. Take a helicopter to ice floes. Navigate the narrows, coves and inlets that filigree the coast of Greenland.

And it can happen aboard a ship as rare as the places it takes you to. The new pleasure-expedition ship M/V Bewa Discoverer, complete with helicopter; fishing station; a duplicate bridge with navigational equipment for you to study; a passenger to officer intercom system; and a special complement of scientists to help you bone up on everything from kittiwake birds to vanished indian tribes to the eskimos up there on the rim of the Arctic Circle.

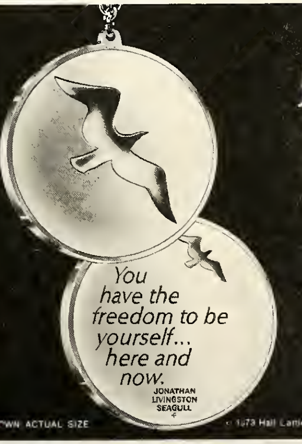
All this *plus* all the pleasureful trimmings of conventional luxury liners. Your expedition cruise leaves July 8th from New York and arrives 24 days and countless memories later in Thule. It's the third of nine M/V Bewa Discoverer cruises to "inaccessible places," all offered exclusively by Thomas Cook, the largest travel organization in the world. Ask your travel agent for our brochure, or send us the coupon below.

Thomas Cook
WORLD TRAVEL SERVICE

Thomas Cook
587 Fifth Avenue
New York, New York 10017
BEWA CRUISES
NH2

Gentlemen: Please send your brochure giving complete details on the new M/V Bewa Discoverer Pleasure Expedition Cruises.

Name__________
Address__________
City__________
State__________ Zip__________
My Travel Agent is__________
M/V Bewa Discoverer is registered in Denmark


You have the freedom to be yourself... here and now.
JONATHAN LIVINGSTON SEAGULL

the Jonathan Livingston Seagull Pendant

. . . to say that the spirit of Jonathan Livingston Seagull lives within you . . .

Minted in your choice of solid sterling silver or 24kt gold electroplate on sterling. With a brilliant proof quality finish. Perfection by The Franklin Mint.

SHOWN ACTUAL SIZE
© 1973 Hall Bartlett

ORDER FORM

The Franklin Mint
Franklin Center, Pennsylvania 19063

Please send the following Jonathan Livingston Seagull pendants, complete with neckchains:

______ QTY Solid sterling silver pendants at $25.00 each $______
______ QTY 24kt gold on sterling pendants at $32.50 each*. $______
*Neckchain gold-filled
Total of order $______
Please add your State sales tax $______
Remittance enclosed $______

Mr.
Mrs.
Miss__________
Address__________
City__________
State, Zip__________
Please allow 4 to 6 weeks for delivery.
31-55

The Franklin Mint is the world's largest and foremost private mint It is not affiliated with the U.S. Mint or any other government agency.

Racist Arguments and I.Q.

"Biological determinism is not simply an amusing matter for clever cocktail party comments about the human animal"

Louis Agassiz, the greatest biologist of mid-nineteenth-century America, argued that God had created blacks and whites as separate species. The defenders of slavery took much comfort from this assertion, for biblical proscriptions of charity and equality did not have to extend across a species boundary. What could an abolitionist say? Science had shone its cold and dispassionate light upon the subject; Christian hope and sentimentality could not refute it.

During the Spanish-American War, a great debate raged over whether we had the right to annex the Philippines. Imperialists again took comfort from science, for social Darwinism proclaimed a hierarchy in racial ability. When anti-imperialists cited Henry Clay's contention that God would not create a race incapable of self-government, Rev. Josiah Strong answered: "Clay's contention was formed before modern science had shown that races develop in the course of centuries as individuals do in years, and that an underdeveloped race, which is incapable of self-government, is no more of a reflection on the Almighty than is an underdeveloped child, who is incapable of self-government."

I cite these examples not merely because they expose science at its most ridiculous, but because they illustrate a far more important point: statements that seem to have the sanction of science have been continually invoked in attempts to equate egalitarianism with sentimental hope and emotional blindness. People who are unaware of this historical pattern tend to accept each recurrence at face value: that is, they assume each such statement arises from the "data" actually presented rather than from the social conditions that truly inspire it.

We have never, I shall argue, had any hard data on genetically based differences in intelligence among human groups. Speculation, however, has never let data stand in its way; and when men in power need such an assertion to justify their actions, there will always be scientists available to supply it.

The racist arguments of the nineteenth century were primarily based on craniometry, the measurement of human skulls. Today, these contentions stand totally discredited. What craniometry was to the nineteenth century, intelligence testing has been to the twentieth. The victory of the eugenics movement in the Immigration Restriction Act of 1924 signaled its first unfortunate effect—for the severe restrictions upon non-Europeans and upon southern and eastern Europeans gained much support from the results of the first extensive and uniform application of intelligence tests in America—the Army Mental Tests of World War I. These tests were engineered and administered by psychologist Robert M. Yerkes, who concluded that "education alone will not place the negro race [*sic*] on a par with its Caucasian competitors." It is now clear that Yerkes and his colleagues knew no way to separate genetic from environmental components in postulating causes for different performances on the tests.

The latest episode of this recurring drama began in 1969, when Arthur Jensen published his article entitled, "How Much Can We Boost I.Q. and Scholastic Achievement?" in the *Harvard Educational Review.* Again, the claim was made that new and uncomfortable information had come to light, and that science had to speak the "truth" even if it refuted some cherished notions of a liberal philosophy. But again, I shall argue, Jensen had no new data; and what he did present was flawed beyond repair by inconsistencies in the data themselves and by illogical claims in his presentation.

Jensen assumes that I.Q. tests adequately measure something we may call "intelligence." He attempts to tease apart the genetic and environmental factors causing differences in performance on these tests. He does this by relying upon the one natural experiment we possess: identical twins reared apart—for here the differences can only be environmental. The average difference in I.Q. for such twins is less than the difference for two unrelated individuals raised in similarly varied environments. From the data on twins, he obtains an estimate of the magnitude of environmental influence and estimates the genetic component from the additional differences in I.Q. between unrelated individuals. He concludes that I.Q. has a heritability of about 0.8 (or 80 percent) *within* the population of American and European whites. The average difference between American whites and blacks is 15 I.Q. points (one standard devia-

Australia is a land apart. Good thing, too. Or we wouldn't have Kookaburras, Kangaroos, Koalas, and a whole lot of other things you can only find Down Under.

Go to Melbourne's Royal Botanical Gardens, they're the finest in Australia. Visit the Sir Colin Mackenzie Sanctuary where the Platypus was first bred in captivity (that's that funny, furry, duck-billed creature that's actually a living fossil).

On Phillip Island see thousands of Fairy Penguins, the world's smallest. Be a guest at a hundred-year-old homestead. The owners are noted bird-watchers and they'll give you the drum* on our feathered mates. Laughing Kookaburras. Gallahs that flit about like tiny Charlie Chaplins (we Aussies call bad drivers "mug gallahs"). Willy Wagtails. Butcher-birds. Masked Owls. And outlandish kinds of parrots.

In Canberra go to the Tidbinbilla Nature Reserve. All sorts of Kangaroos, lots of them carrying their joeys*. Not to mention Swamp Wallabies, Ring-tailed Possums, Emus (those big silly birds that can't fly a lick), shy bush animals.

In Sydney take a ferry to the Taronga Zoo Park and Aquarium. Inside, fantastic water and wildlife. Outside a bonzer* harbor view, with Sydney's hundred-million-dollar Opera House looking like a mammoth space-age sailboat.

See the Koala Sanctuary in Brisbane. 150 cute slow-pokey Koalas, and cuddling is encouraged. And while you're there visit jungly Lamington National Park. Over 500 waterfalls, orchids thick as weeds, Lyrebirds (if you're lucky you can catch one in a courtship dance).

Naturally, you won't just be taking in our flora and fauna; you'll be enjoying our fine tucker*, and having a good drop* with us Aussies. We're a rare species, too. Don't know how to be unfriendly, so very quickly you become our mates. It'll be a beaut trip.

Just mail in the coupon and we'll tell you more about our reasonably-priced prepackaged wildlife tours. Of course, if you prefer an individual tour, your Travel Agent will gladly plan one for you.

*__The Drum__/the truth *__Joey__/baby kangaroo *__Bonzer__/great *__Tucker__/food *__Good Drop__/drink

Australian Tourist Commission Dept. N1
1270 Avenue of the Americas, N.Y., N.Y. 10020
3550 Wilshire Blvd., Los Angeles, Calif. 90010

Already I'm wild for Australia's wildlife.
Please send me literature on
☐ Birds ☐ Flora ☐ Fauna
I'm interested in ☐ Group Tours
☐ Individual Itineraries

Name ______________________
Address ______________________
City ______________ State ______ Zip ______

AUSTRALIA Where the good old days are now.

There's Nothing Like It!

Wonderful Sight Light

No Glare . . . No Squint . . .

Contemporary Model

Traditional Model

Specially designed optical system uses standard bulb

Up to 5 times the light of conventional lamps . . . yet completely glareless!

- ✶ READING SMALLEST PRINT
- ✶ SEWING BLACK ON BLACK
- ✶ FULLY ADJUSTABLE

Satin brass combined with base and shade in Black, White or Avocado

Traditional	$67.50
Contemporary	$54.50
Overall Satin Brass (Contemp. only)	$72.00

Buy America's Favorite Reading Lamp
Shipment Postpaid • Check or M.O.

LIGHT-CRAFTERS
Dept. T-3
Ten Lexington Avenue
Greenwich, Conn. 06830

We sell only by mail . . . write for nearest Sight Light stores.

From The Horchow Collection

FORMERLY THE KENTON COLLECTION

THE IDEA BASKET.
This imported white glazed ceramic basket is only 7-3/16″ x 5½″ x 7½″, but it's big on ideas. Fill it with flowers, candy, cocktail goodies or your knitting. Give a kid a kitten in it. Got another idea? We thought you would. #2677A 10.00. (1.65 postage & handling).

THE HORCHOW COLLECTION,
P.O. BOX 34257, DEPT. 01940
DALLAS, TEXAS 75234

☐ Please send the new Horchow Collection Catalogue.

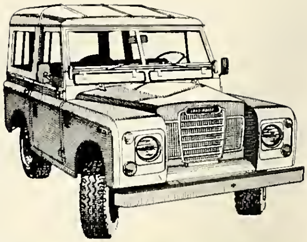
tion). He asserts that this difference is too big to attribute to environment, given the high heritability of I.Q. Lest anyone think that he writes in the tradition of abstract scholarship, I merely quote the first line of his famous work: "Compensatory education has been tried, and it apparently has failed."

I believe that this argument can be refuted in a "hierarchical" fashion—that is, we can discredit it at one level and then show that it would fail at a more inclusive level even if we allowed Jensen's argument for the first two levels:

Level 1: The equation of I.Q. with intelligence. Who knows what I.Q. measures? It is a good predictor of "success" in school, but is such success a result of intelligence, apple polishing, or the assimilation of values that the leaders of society prefer? Some psychologists get around this argument by defining intelligence operationally as the scores attained on "intelligence" tests. A neat trick. But at this point, the technical definition of intelligence has strayed so far from the vernacular that we no longer can define the issue. But let me allow (although I don't believe it), for the sake of argument, that I.Q. measures some meaningful aspect of intelligence in its vernacular sense.

Level 2: The heritability of I.Q. Here again, we encounter a confusion between vernacular and technical meanings of the same word. "Inherited," to a layman, means "fixed," "inexorable," or "unchangeable." To a geneticist, "inherited" refers to an estimate of similarity between related individuals based on genes held in common. It carries no implication of inevitability or of immutable entities beyond the reach of environmental influence. Eyeglasses correct a variety of inherited problems in vision; insulin can check diabetes.

Jensen insists that I.Q. is 80 percent heritable. Princeton psychologist Leon J. Kamin has recently done the dog-work of meticulously checking through details of the twin studies that form the basis of this estimate. He has found an astonishing number of inconsistencies and downright inaccuracies. For example, the late Sir Cyril Burt, who generated the largest body of data on identical twins reared apart, pursued his studies of intelligence for more than



The fully-equipped Land-Rover. $4599,* Mystique and all.

The 4wd Land-Rover has been climbing mountains, fording rivers, crossing deserts, exploring jungles—and starring in movies—for more than 25 years.

That's why Land-Rover is considered indispensable equipment for every kind of exploration. From a camp-out on the Cape to a summer safari across the Sahara.

The base price of a Land-Rover is $4599. And at $4599, it's fully-equipped. Not stripped-down.

Land-Rover has standard equipment that some others provide as extra-cost options, if at all. Like 4-speed transmission, power-assisted brakes, corrosion resistant all-aluminum body, hard-top, rear door, 3 power take-off points, all-purpose tires and a deluxe interior with fully upholstered seats for 7.

Go test price a Land-Rover today. You'll discover more basics than you bargained for.

For the name of your nearest dealer call: 800-447-4700.
In Illinois call: 800-322-4400.

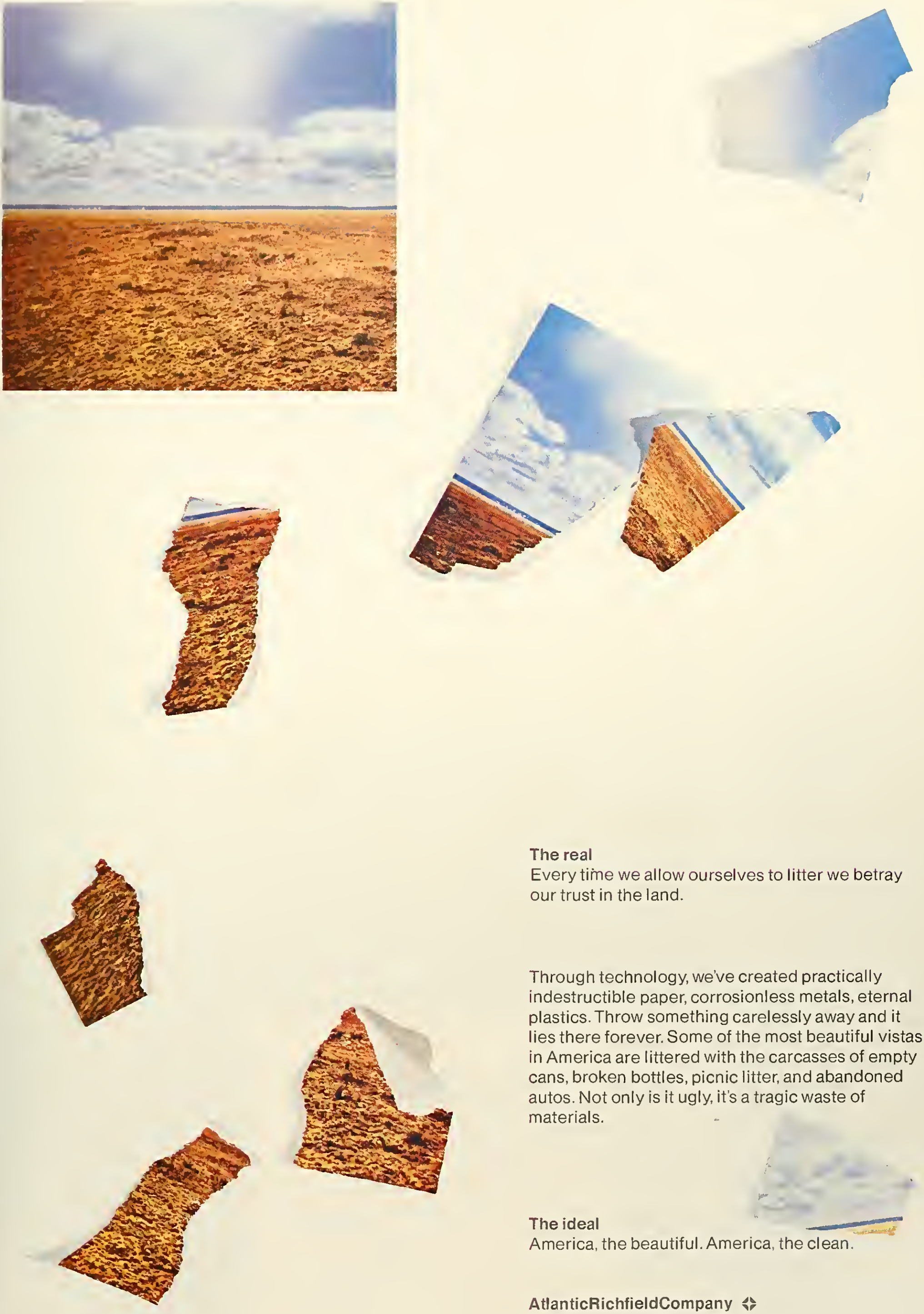
*Manufacturer's suggested retail price. P.O.E. Does *not* include inland transportation, local taxes or preparation charges.

Land-Rover
British Leyland Motors Inc.
Leonia, New Jersey 07605

BRITISH LEYLAND

STANDARD EQUIPMENT: On the new Series III Land-Rover we offer an all synchromesh gearbox (4 forward speeds and reverse, plus a 2-speed transfer box, equals 8 forward, 2 reverse); alternator; larger capacity heater; improved power brakes plus new facia and other styling advances.

As always: Four wheel drive. Full length metal top. Body of corrosion resistant aluminum alloy with sliding side windows. Side-hinged rear door. Seats for seven. Windshield ventilators with built in fly screens. Dual braking system. Windshield washers. Back-up lights. Fresh air heater and defrosters.



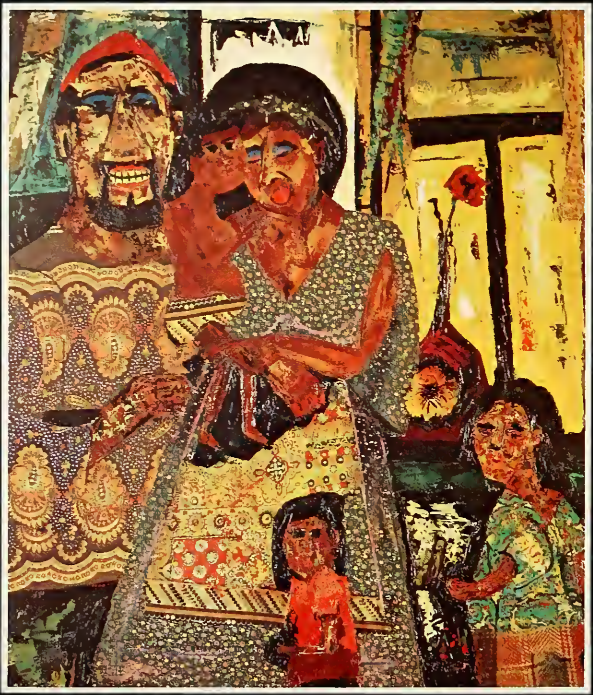
The real
Every time we allow ourselves to litter we betray our trust in the land.

Through technology, we've created practically indestructible paper, corrosionless metals, eternal plastics. Throw something carelessly away and it lies there forever. Some of the most beautiful vistas in America are littered with the carcasses of empty cans, broken bottles, picnic litter, and abandoned autos. Not only is it ugly, it's a tragic waste of materials.

The ideal
America, the beautiful. America, the clean.

AtlanticRichfieldCompany ◆

SPEND A YEAR IN ANOTHER WORLD. $15. BRING THE WHOLE FAMILY.



The Black Family • Collage Painting VINCENT SMITH

The world of OMEGA JOURNAL.

OMEGA, a quarterly fine arts and literary journal created to help you develop and explore the universe of your own imagination.

Each issue will contain twelve to twenty color and black and white plates printed separately on the finest quality paper, and tipped into the publication. Each 10" x 15" page is easily removable for framing.

OMEGA will bring you a portfolio of works by accomplished artists from all over the world. Photography, woodcut, sculpture, oil and water color are just a few of the media with which you will become acquainted.

Other worlds. Other people. Other cultures. You'll find them in every exciting issue of OMEGA. It's a publication for you. It's a publication for your family. Because, after all, how your children see the world depends on what you show them.

To begin your subscription, complete the coupon below or write to OMEGA HOUSE Ltd., PO Box 1100, New York, NY 10011.

OMEGA Ω

Please enter my subscription for one year of the OMEGA JOURNAL at $15.

Enclosed is: ( ) Check ( ) Money order

( ) American Express ( ) BankAmericard ( ) Mastercharge

Charge Number . . . . Expires . . . .

Signature . . . .

Name . . . .

Address . . . .

State . . . . Zip . . . .

OMEGA HOUSE Ltd., PO Box 1100, New York, NY 10011.

forty years. Although he increased his sample sizes in a variety of "improved" versions, some of his correlation coefficients remain unchanged to the third decimal place—a statistically impossible situation. Other studies did not standardize properly for age and sex. Since I.Q. varies with these properties, an improper correction may produce higher values between twins not because they hold genes for intelligence in common, but simply because they share the same sex and age. The data are so flawed that no valid estimate for the heritability of I.Q. can be drawn at all. But let me asssume (although no data support it), for the sake of argument, that the heritability of I.Q. is as high as 0.8.

Level 3: The confusion of within- and between-group variation. Jensen draws a causal connection between his two major assertions—that the within-group heritability of I.Q. is 0.8 for American whites, and that the mean difference in I.Q. between American blacks and whites is 15 points. He assumes that the black "deficit" is largely genetic in origin because I.Q. is so highly heritable. This is a *non sequitur* of the worst possible kind—for there is no necessary relationship between heritability within a group and differences in mean values of two separate groups.

A simple example will suffice to illustrate this flaw in Jensen's argument. Height has a much higher heritability within groups than anyone has ever claimed for I.Q. Suppose that height has a mean value of five feet two inches and a heritability of 0.9 (a realistic value) within a group of nutritionally deprived Indian farmers. This high heritability simply means that short farmers will tend to have short offspring, and tall farmers tall offspring. It says nothing whatever against the notion that proper nutrition could raise the mean height to six feet (taller than average white Americans). It only means that, in this improved status, farmers shorter than average (they may now be five feet ten inches) would still tend to have shorter than average children.

I do not claim that intelligence, however defined, has no genetic basis—I regard it as trivially true, uninteresting, and unimportant that it does. The expression of any trait represents a complex interaction of heredity and environment. Our job is simply to provide the best environmental situation for the realization of valued potential in all individuals. I merely point out that a specific claim purporting to demonstrate a mean genetic deficiency in the intelligence of American blacks rests upon no new facts whatever and can cite no valid data in its support. It is just as likely that blacks have a genetic advantage over whites. And, either way, it doesn't matter a damn. An individual can't be judged by his group mean.

If current biological determinism in the study of human intelligence rests upon no new facts (actually, no facts at all), then why has it arisen from so many quarters of late? The answer must be social and political—and the sooner we realize how much of science is so influenced, the sooner we will demythologize it as an inexorable "truth-making machine." Why now? The 1960s were good years for liberalism; a fair amount of money was spent on poverty programs and relatively little happened. Enter new leaders and new priorities. Why didn't the earlier programs work? Two possibilities are open: (1) we didn't spend enough money, we didn't make sufficiently creative efforts, or (and this makes any established leader jittery) we cannot solve these problems without a fundamental social and economic transformation of society; or (2) the programs failed because their recipients are inherently what they are—blaming the victims. Now, which alternative will be chosen by men in power in an age of retrenchment?

I have shown, I hope, that biological determinism is not simply an amusing matter for clever cocktail party comments about the human animal. It is a general notion with important philosophical implications and major political consequences. As John Stuart Mill wrote, in a statement that should be the motto of the opposition: "Of all the vulgar modes of escaping from the consideration of the effect of social and moral influences upon the human mind, the most vulgar is that of attributing the diversities of conduct and character to inherent natural differences."

Columnist Stephen Jay Gould teaches geology at Harvard University.

QUESTAR PHOTOGRAPHS CLAVIUS

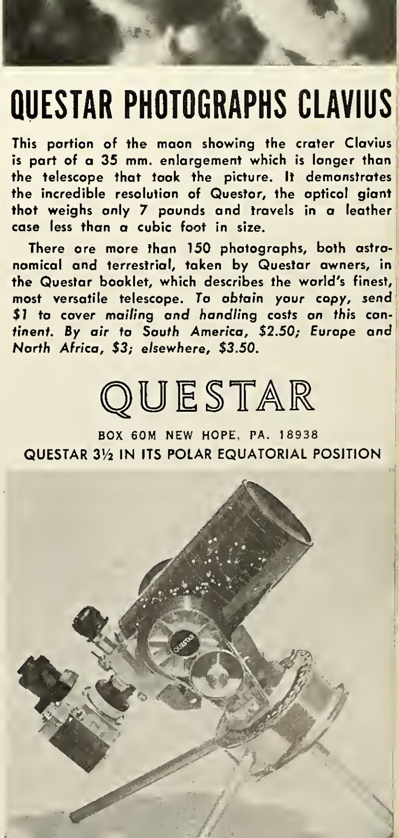
This portion of the moon showing the crater Clavius is part of a 35 mm. enlargement which is longer than the telescope that took the picture. It demonstrates the incredible resolution of Questar, the optical giant that weighs only 7 pounds and travels in a leather case less than a cubic foot in size.

There are more than 150 photographs, both astronomical and terrestrial, taken by Questar owners, in the Questar booklet, which describes the world's finest, most versatile telescope. *To obtain your copy, send $1 to cover mailing and handling costs on this continent. By air to South America, $2.50; Europe and North Africa, $3; elsewhere, $3.50.*

QUESTAR

BOX 60M NEW HOPE, PA. 18938

QUESTAR 3½ IN ITS POLAR EQUATORIAL POSITION



Birth of a Harbor Seal

If it is to survive, a pup must monopolize its mother's attention

by Peter M. Knudtson

The pregnant cow seal is restless. She hitches her swollen body across the mud flat, her stubby fore flippers slapping rhythmically as they pull her along. She pauses for a moment, her eyes glazed and unseeing, then lifts her hind flippers high in the air in obedience to unseen internal forces. In an explosion of brilliant red she gives birth to her pup. The newborn seal is jettisoned head first from its mother's womb into a cold world of mud and water; the umbilical cord is severed by the force of the expulsion. At the instant of birth two gulls alight nearby, ready to consume the detritus of parturition.

Stunned and seemingly unaware of each other, mother and pup lie still upon the mud for several seconds. Then the cow approaches her pup and begins to nose it, sniffing deeply of the warm odors by which she will identify her offspring in the weeks to come.

The dark and slender form of the pup also comes to life—first thrashing awkwardly across the mud, then rushing headlong into the chill waters of the bay's rising tide. Within moments the precocial pup is swimming strongly, its mother in close pursuit. As dusk begins to smother the greens and blues of late afternoon, both are lost in the mirror surface of the windless bay.

Such are the first moments of what may be the most enduring social bond in the life of the Pacific harbor seal (*Phoca vitulina richardi*). Following a birth so ephemeral that few human observers have witnessed it, the cow and her pup embark upon a phase of their lives that will bind them in an intimate relationship lasting almost six weeks. It is a bond marked by a continuity that contrasts with the apparent social indifference of adult harbor seals.

The life cycle of the harbor seal is not well understood, and despite the wealth of anatomical and physiological information the animal has yielded in the laboratory, it remains largely an enigma to ethologists.

Groups of Pacific harbor seals emerge from the water to rest on offshore rocks, sandbars, and tidal mud flats in a range that extends from Baja California to the Bering Sea. In some areas along the coast these aggregations are seasonally enlarged by the arrival of pregnant females returning to traditional rookeries to bear their young.

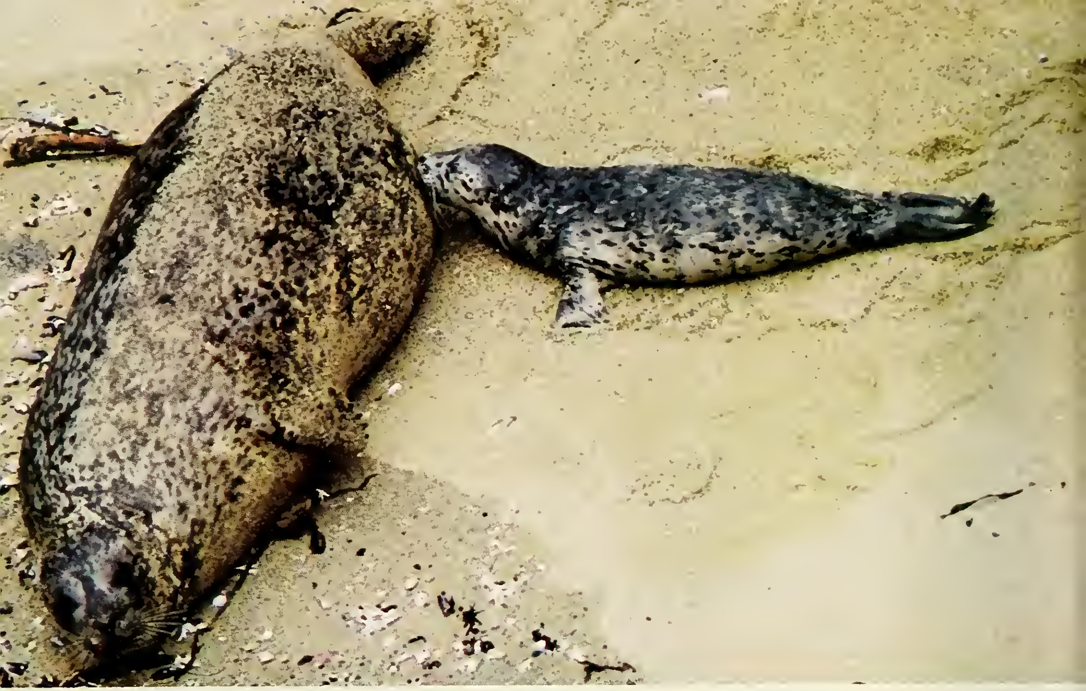
One such rookery is in Humboldt Bay, a broad and shallow body of water that serves as a harbor for the city of Eureka in northern California. With each low tide, the drainage of the bay's waters into the sea exposes a vast, channel-rift plain of mud, which serves as a hauling, or terrestrial resting, ground for the seals. Hundreds of them emerge from the murky waters during each ebb to "haul out" upon the mud flats in widely scattered herds. After several hours, the rising tide covers the bay's muddy bottom, and the seals retreat into the water.

During the first months of the year, the immigration of seals into the southern reaches of the bay is most likely the result of a local centripetal movement of seals from the surrounding coastal hauling areas rather than a linear migration.

Lacking the temporal and spatial integrity of sea lion or fur seal rookeries, the harbor seal herds appear to be almost casual associations, which dissolve with each flood tide and re-form, seemingly without plan, on each ebb. Mothers with pups wander freely from herd to herd, often staying on the peripheries, where haul-out space is less competitive. Other seals lie on their sides or bellies in a mass lethargy that only rarely erupts into sporadic, fore-flipper-waving disputes between neighbors. This extremely low level of activity and the difficulty in determining the sexual composition of the herd (harbor

Constantly watched by its mother, a harbor seal pup strengthens its swimming skills in a bed of kelp off the California coast.

JEFF FOOTT, BRUCE COLEMAN, INC.



JEFF FOOTT, BRUCE COLEMAN, INC.

Nursing from a retractable nipple, in five or ten minutes a pup obtains enough nourishment from its mother's rich milk to sustain it for several hours.

seals exhibit little sexual dimorphism) have almost completely obscured the dynamics of harbor seal social life.

In 1973, the births began in Humboldt Bay in late March and peaked in late April, when there were 88 sleek pups and their mothers scattered throughout the colony of 337 seals. For the first days after the brief episode of parturition, mothers and pups face a test of endurance. Although the pup is capable of swimming within a few minutes of birth, it is forced to remain in the water for hours at a time while the hauling grounds are under water. Thus, the selective value of precocity in young harbor seals is apparent.

In the face of such demands on her pup, a mother will frequently carry it piggyback as she swims, becoming a living, mobile hauling ground for her offspring as the two dive and surface in graceful tandem.

Although aquatic nursing has been reported in harbor seals of the British Isles, the nursing activities observed in Humboldt Bay were strictly terrestrial. To make the nursing connection the cow rolls on her side, presenting a pair of retractable nipples situated low on her abdomen. With a facility that improves as the weeks pass, the pup locates a teat and suckles, periodically switching from one nipple to the other. Nursing sessions usually last five to ten minutes, but may be spaced several hours apart because the rich milk of harbor seals contains as much as 45 percent fat.

Occasionally a pup will show a reluctance to nurse. When this happens, the mother will urge her offspring by waving a raised fore flipper at the recalcitrant youngster (a threat gesture common among adult harbor seals); or she may gently nudge the pup toward her belly with her fore flipper.

The pup's growth over the weeks is testimony to the success of the feeding regimen. Weighing about twenty-five pounds at birth, a pup may more than double its body weight by the end of the five- to six-week nursing period, metabolizing the fat-laden milk into insulating capsules of blubber.

Looking like tiny, bloated caricatures of adults, suckling harbor seal pups wallow beside their mothers on the hauling grounds. Their eyes are ringed with circles of tears because this species lacks any nasolacrimal duct to drain eye fluids into the nose. This is a feature shared by other marine mammals whose aquatic habits make such a conduit unnecessary. The velvety coats of the pups are mottled silver and black. While still in its mother's uterus, each pup had a pale and silky fetal coat known as lanugo, but this was shed and replaced by the present pelage before birth.

The pups coo softly and sometimes flail their fore flippers or nip playfully at their mothers—often displaying crude but recognizable elements of adult behavior. Unlike sea lions or fur seals, whose pups lead active and playful lives within highly structured, territorial breeding colonies, unweaned harbor seals do not interact with each other or with other adults. Thus, the ontogeny of a harbor seal pup seems to take place in nearly a social vacuum. Realizing the role that the maternal bond plays in the socialization of some animals, it becomes tempting to speculate on its effect on harbor seal society. Perhaps such a socially insulative bond plays a part in creating a harbor seal social system in which adults interact only rarely outside of sexual encounters—in what might be called a seal "society of strangers" when compared with more gregarious pinnipeds.

As they rest on land, mothers periodically nose their pups, as they have done from the moment of birth. It seems an effective means of identification, for evidence suggests that mothers can distinguish strange pups and will nurse only their own. Even as they swim through the labyrinth of channels that course through the mud flats of low tide, a mother seal continuously monitors her pup's presence by nosing it each time the pair surface from a dive.

In contrast to the almost mute

Overleaf: Nuzzling her offspring, a cow reinforces the olfactory clues that enable her to identify her own pup among all the others in the rookery.

JEFF FOOTT, BRUCE COLEMAN, INC.

The pup's coat, now mottled, was once a pale and silky fetal coat known as lanugo.

JEFF FOOTT, BRUCE COLEMAN, INC.

The absence of external ears marks the harbor seal as a member of the Phocidae, or true seals. The ear holes close when the seal submerges.

PETER M. KNUDTSON

adult, a harbor seal pup is a vocal creature. After a disturbance, the pups' chorus of plaintive cries shatters the otherwise almost total silence of the rookery. Should a storm separate a mother from her pup, the pup's hoarse and unilateral call will enable the mother to navigate to its side, where she will perform the final olfactory test of ownership.

By the discriminating powers of olfactory, acoustic, and, perhaps, visual communication, harbor seal cows maintain the exclusive bond with their pups. The bond is continuous until the pup is weaned—a mother will not abandon her pup for even brief periods of time unless disturbed. As a result, it is likely that harbor seal mothers either fast or feed sparingly until their pups are weaned. And, in an abstinence imposed by motherhood, the cow will aggressively thwart the ardent approaches of bulls.

Not until after weaning, when she is unencumbered by maternal duties, is the female ready to mate again in an aquatic union—the details of which have eluded naturalists for years. A harbor seal cow is thought to enter estrus a few weeks after her pup is weaned. Although it is not uncommon to see pairs of seals engaging in rolling aquatic interactions at this time—nuzzling, splashing, diving, and sometimes mounting briefly at the water's surface—the sexes can seldom be distinguished.

Aquatic copulation after an estrus-free maternal bond may help to explain the absence of harems or territories in the harbor seal—familiar features of the highly structured societies of otariids, or eared seals, that have aptly been called "cities of seals." In a seal species in which mothers are not sexually receptive until after their land-based nursing obligations are complete, a male breeding strategy of land partition would not be adaptive. In a species in which estrus occurs during nursing, however, territoriality would provide males with exclusive access to receptive females.

That the former strategy characterizes most phocids (including harbor seals), and the latter the otariids, suggests that selective pressures may have appeared early in these pinniped lines. Of the Phocidae, or true seals, only the elephant seal and the gray seal appear to mate before weaning.

What these hypothetical selective pressures may have been remains speculation, as does much of pinniped phylogeny itself. If, as some biologists believe, the phocid line emerged from an otterlike ancestor that inhabited the inland waterways of Tertiary Asia, predatory pressures may have been crucial. Unlike the shy, early otariids that formed rookeries on offshore rocks and islands, the protophocid may have been especially vulnerable to land predators. Predation, especially during the reproductive phases of its life cycle, may have selected for a creature that mated in the protective cover of water and provided brief but intensive care for its offspring in a maternal bond undisturbed by the distractions of mating—one not unlike that of the most primitive of true seals, including the harbor seal.

In a society built upon such a primitive phocid breeding plan, harbor seal males would be expected to adopt the more effective strategy of promiscuity. Focusing not on the land resource, which in many otariids guarantees access to receptive females, but instead on the mobile females themselves, a harbor seal bull might consort with an individual cow as she approached estrus. After the onset of estrus and an aquatic copulation, however, a bull might then move on in search of other potential mates among the postweaning receptive females. Encounters between rival bulls would result in battles and possibly in the formation of bachelor herds of subordinate males. Herds composed, as far as could be determined, entirely of adult males have, in fact, been seen in the Humboldt Bay rookery.

The notion of such a promiscuous system, built upon a primal maternal bond that precludes breeding, lends order to what otherwise seems an anonymous horde of seals. But until more evidence emerges, it remains speculation, and the sex life of this society remains the harbor seal's secret. □

Season of the Apple

April 26: I drove to the university orchards to inspect the twelve Golden Delicious apple trees whose leaves I will be collecting for biochemical analysis of nitrogen utilization. The leaves are quite small, but the pink tips of the blossom clusters are visible. The blossoms of the Red Delicious trees in the next row are just opening, while the Jonathan trees a few rows over are in full bloom, with a profusion of delicate, fragrant, pinkish blossoms. I saw many honeybees flitting through the trees.

In late April and early May, a large, mature apple tree produces between 50,000 and 100,000 blossoms, usually in clusters of five or six. No wonder the tree is so lovely in the spring. Most of the blossoms are attached to spurs, or short woody shoots, but some maverick blossoms bloom singly on the longer vegetative shoots.

In each cluster of blossoms the terminal, or tip, blossom opens its corolla of five petals first, followed by the two blossoms at the base of the cluster, and then the two or three in the middle. This progression of opening blossoms keeps the apple tree in bloom longer than many other trees. Jonathan trees, for example, may be in bloom for up to three weeks.

If all 50,000 or more blossoms were to set fruit, the tree would produce as many as 800 bushels of apples, although each fruit would be quite small. A single tree, however, cannot support the weight of so many apples, nor can it supply them with the nutrients and water they need for growth. The development of fruit from all its blossoms would so sorely deplete a tree that future growth would be impaired, if not impossible. Even the fruiting of 20 percent of its blossoms would be prohibitive, resulting in no blossoming at all the following year while the tree replenished its food reserves. Usually a mere 2 to 5 percent of the apple blossoms set fruit that develops to maturity. This represents a yield of fifteen to thirty bushels of apples for a large, mature tree.

May 10: The Golden Delicious trees have dropped most of their blossoms. Blossoms and petals cover the ground. The leaves are larger now but still too small for sampling. Two or three pea-sized fruitlets are growing in each blossom cluster.

An apple tree reduces its potential load and, at the same time, insures that the remaining fruits contain as many seeds as possible by two major "thinning mechanisms." The first comes into play soon after the blossoms open. Although an apple blossom is classified as a "perfect" flower because it has both male stamen and female pistil parts, the blossom must be cross-pollinated. With few exceptions, all apple varieties are self-unfruitful or self-incompatible—the pollen of one variety will not fertilize a blossom of the same variety. Another variety must be blooming nearby to furnish pollen for cross-pollination.

But even when another is blooming nearby, pollination is no simple matter. While an apple blossom remains open for two to five days, depending on the weather, the discharge of pollen from its twenty stamens occurs only during one three- to four-hour period. Pollinating insects, especially honeybees, must be available to transfer the pollen from one blossom to another. As the pollen is discharged, the blossom's ethyl acetate aroma is released, attracting insects from as far as a thousand feet away. But if the temperature is below 65°F., if it is raining heavily, or if the wind is too strong, honeybees will remain in their hives and the pollen will be released to little avail.

Within a few days, the unpollinated blossoms fall from the tree in what is called the "first wave" of blossom drop. About 65 to 75 percent of the blossoms fall at this time. The remaining, pollinated blossoms drop only their petals and stamens, but their continuation is far from assured.

The blossoms must now be fertilized. Within a few hours of landing on the blossom's pistil, the pollen grains germinate by producing a pollen tube, a protuberance that penetrates the surface of the stigma and makes its way downward through the style of the pistil. The pollen tube is aided in its passage by the production of several enzymes, which dissolve or digest the

A time to blossom,
a time to ripen,
a time to harvest,
and a time to prepare
for next year's fruit

by Patricia W. Spencer

tissues of the style. Pollen that has landed on a blossom of the same variety (usually from the same tree) is prevented from penetrating deeply into the style by the presence of an inhibitory substance in the pistil. Pollens of other varieties, however, contain a substance that overcomes this inhibitor.

This mechanism of self-incompatibility is the reverse of antibody formation in animals, whereby an animal's body "recognizes" and rejects foreign substances. In the apple blossom, the pistil recognizes and rejects self. A self-pollinated blossom will abort before fertilization and fall during a second wave of blossom drop.

June 2: I collected the first sampling of leaves for biochemical analysis. For the next few months, I will be collecting leaf samples every week or so to see how the leaves use, and eventually lose, nitrogen. The developing fruits, now slightly larger than marbles, are quite evident. One fruitlet in each cluster is much larger than the others.

When the pollen tube reaches and penetrates the ovary, which is at the base of the apple blossom, the male germ cells it carries unite with the egg cells. The ovary contains five compartments, called carpels, arranged like a five-pointed star; each point of the star is one carpel containing two ovules.

Each ovule that is fertilized will begin to develop into a seed bearing the embryo formed by the union of male and egg germ cells. If all ten ovules are fertilized, the mature apple will contain ten seeds, two in each carpel. (Some specially bred varieties, however, have more than two ovules in each carpel and therefore can have more than ten seeds.) An apple having more than five seeds is considered well fertilized, while one with fewer than four seeds is poorly fertilized.

For several weeks after fertilization, the fruitlet's tissues grow rapidly, mainly by cell division. The ovule surrounding the embryo begins to develop into the seed coat. The ovarian tissues in the vicinity of a growing ovule enlarge, as does the tissue surrounding the ovary, which eventually becomes the edible flesh of the apple. The rate of growth and cell production in these tissues depends upon an adequate supply of nutrients; those fruitlets receiving more nutrients than others will grow more rapidly.

The formation of seeds in the ovary triggers the production of certain plant hormones, including auxin, which facilitate the uptake of nutrients into the growing fruitlet. The fruitlet derives its nutrition from two sources: from the roots it obtains water and minerals, especially nitrogen for the synthesis of proteins; and from the leaves on the same branch it obtains carbohydrates and amino acids, which the leaves produce by photosynthesis. It takes about thirty leaves to furnish one fruit with all the carbohydrates it needs to mature.

The hormones produced in the seeds act to draw nutrients, especially those from the leaves, into the fruit. A fruitlet with a greater complement of its possible ten seeds produces more of these hormones, which, in turn, induce a greater uptake of nutrients into that fruit.

June 15: The ground under the trees is strewn with small fruits about half an inch in diameter or larger. Of the remaining fruits on the tree, most are in the terminal position in the cluster. Only a few clusters have more than one fruit remaining.

The terminal blossom in each cluster, which opened first, usually sets fruit. And because its ovules have a longer life than those in the side blossoms, allowing for a longer period during which fertilization can occur, it is also usually more highly fertilized than the side blossoms in the same cluster. Hence its name, the "king fruit." Since the king fruit is highly fertilized, containing many developing seeds, it produces more of the hormones that facilitate nutrient uptake. With a greater input of nutrients, the king fruit gains a lead on the other fruitlets in its cluster, and within a few weeks after fertilization, it is already two or three times larger than the side fruits.

If the spur bearing a fruitlet cluster is strong, with many leaves to produce carbohydrates, then it will provide adequate nutrition for more than one fruit. Even those fruitlets producing smaller quantities of hormones than the king fruit will obtain enough nutrients to grow. If, however, the spur is weak or if many of its leaves have been damaged by insects, its supply of nutrients will be reduced, and the king fruit, with its greater production of hormones, will usurp the available nutrients. The side fruitlets will languish from malnutrition. In extreme cases, not even the king fruit can obtain adequate nutrition and will succumb.

Within five or six weeks of full bloom, those fruitlets lagging behind in nutrition will die, falling from the tree in what is called the "June drop." Since these fruits are one-half to one inch in diameter, their presence on the ground is quite noticeable. In general, these dropped fruits contain fewer seeds than those persisting on the tree.

The release of undernourished fruitlets is the second major thinning mechanism by which an apple tree reduces its load while insuring a high yield of seed in the fruits remaining. Perhaps 6 to 8 percent of the original blossoms remain on the tree as fruitlets after the June drop.

> *July 9:* The leaves I collected today are full sized and have been producing more chlorophyll daily. The apples on the trees are as large as Ping-Pong balls and growing slowly.

While an apple seems to grow rather uniformly, this external appearance belies what is occurring internally. Up to this point, the main increase in size has occurred in the apple's ovary and core. The embryos in their respective seeds are almost full sized. The seed coats are well developed but still white and moist. The ovarian tissue takes up most of the apple's volume, while the tissues forming the main part of the edible flesh are still quite small and compact.

The demand for nutrients is still great. If you slice a mature apple horizontally, you will see ten tiny points just outside the core lines. These points in the edible flesh are cross sections of the ten vessels that have carried nutrients from the apple stem into the fruit. Since the movement of nutrients through these vessels is influenced by the hormones produced in the seeds, more nutrients will pass through those vessels that lead to carpels with seeds. If, therefore, one side of an apple has fertilized seeds while the other does not, the apple will receive an unbalanced supply of nutrients and its flesh will grow unevenly. At maturity, such an apple will be lopsided in appearance.

In mid-July the apple's internal metabolism undergoes a change. Now slightly more than one inch in diameter, the apple stops producing new cells; all further enlargement results from an increase in the size of the existing cells and from the formation of air spaces between the cells in the flesh. By means of a great uptake of water, the cells in the flesh more than double in volume. At maturity, more than 83 percent of the apple's weight is water, while the air spaces account for up to 25 percent of the volume of the apple.

When the apple's metabolism changes, the seeds are almost complete. The seed coats are drying out and turning brown. The flesh of the apple now begins to fill out.

> *July 27:* The leaves are nearing their peak. The apples have been growing for three months and are more than two inches in diameter. I can now distinguish between the Jonathan and Red Delicious apples.

As anyone familiar with apples knows, each variety has certain distinguishing characteristics. The apple's general size, shape, taste, and hardiness are strictly maternal, or ovarian, features. Regardless of the pollen that fertilizes the apple blossom, the apple itself will bear "true" to the maternal stock on which it is growing. In most cases, to maintain a variety the parent tree must be propagated by budding or grafting.

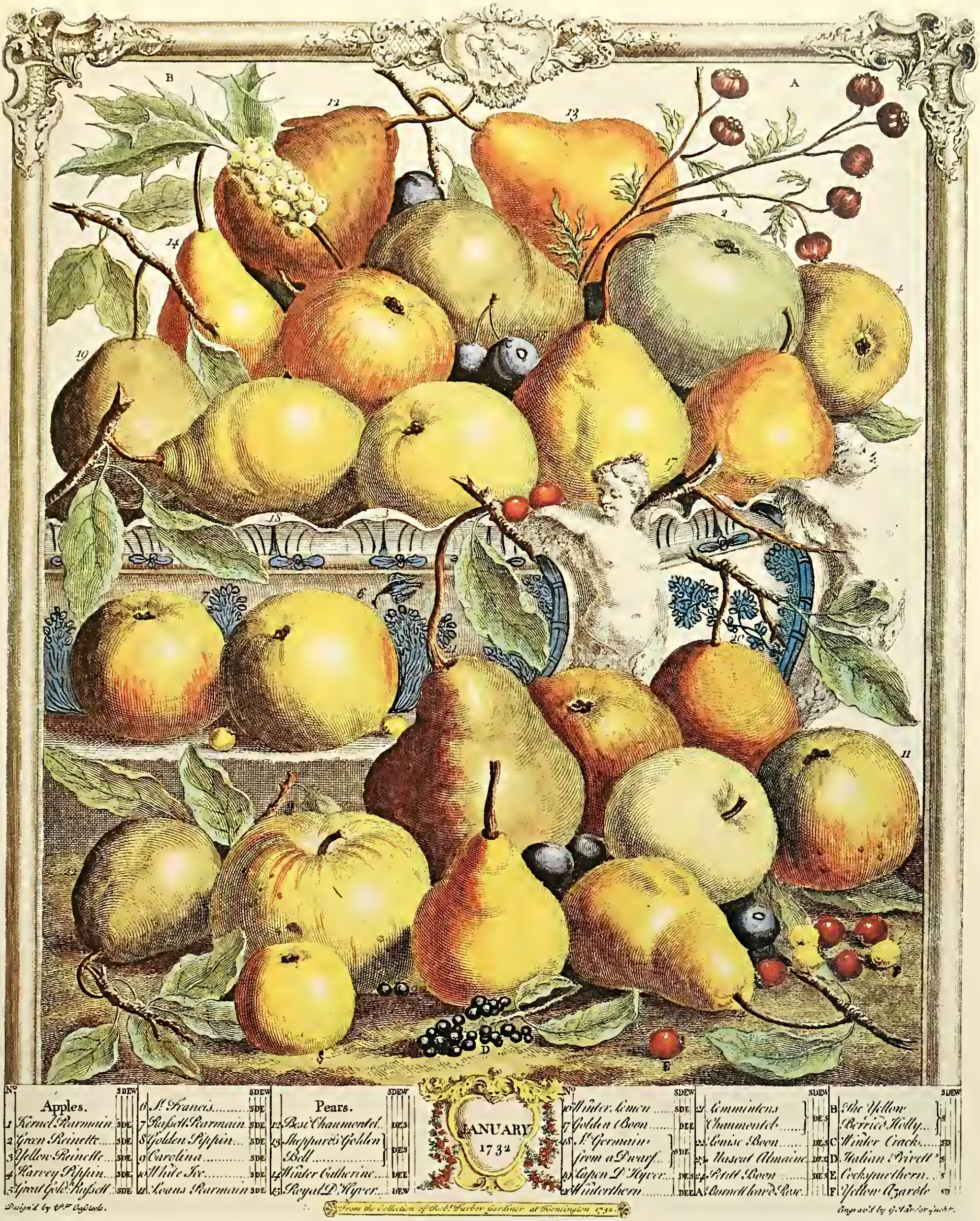
The seeds, however, as a result of cross-pollination, combine the genetic characteristics of two varieties. A tree resulting from one of these seeds will bear apples different from either of its parent varieties. This is a new apple variety. In this respect, apples are like human children: they bear some resemblance to both their parents but also have features all their own, a characteristic that accounts for the great proliferation of apple varieties. At present, more than 7,000 varieties of apples have been named and propagated in the United States alone. Each descended from seeds that early settlers brought over from Europe; only the crab apple is indigenous to North America.

Of the 7,000 varieties, 35 command about 95 percent of the apple crop. The leading variety, Red Delicious, was discovered in the mid-1800s as a chance seedling in an orchard in Iowa. The Golden Delicious, discovered in 1916 in the mountains of West Virginia, bears no relation.

> *August 15:* The leaves I collected this morning have reached their peak of growth. Those on the trees will soon begin to lose nitrogen. The apples are approaching full size. Many, damaged by disease and insects, have dropped to the ground. Others still on the tree appear damaged and will probably drop.

External factors also play a role in reducing the size of an apple crop. A multitude of insects lay their eggs either on the leaves or directly on the fruit. Larvae that hatch on the fruit bore into the skin and eat the apple flesh. The worst insect pest is the codling moth, whose larva is the familiar "worm" in the apple.

Several viral, fungal, and bacterial diseases also take their toll on the growing apples. The primary apple disease, especially in the east, is apple scab, which is caused by the fungus *Venturia inaequalis.* Afflicted fruits have a scabby, knotty,



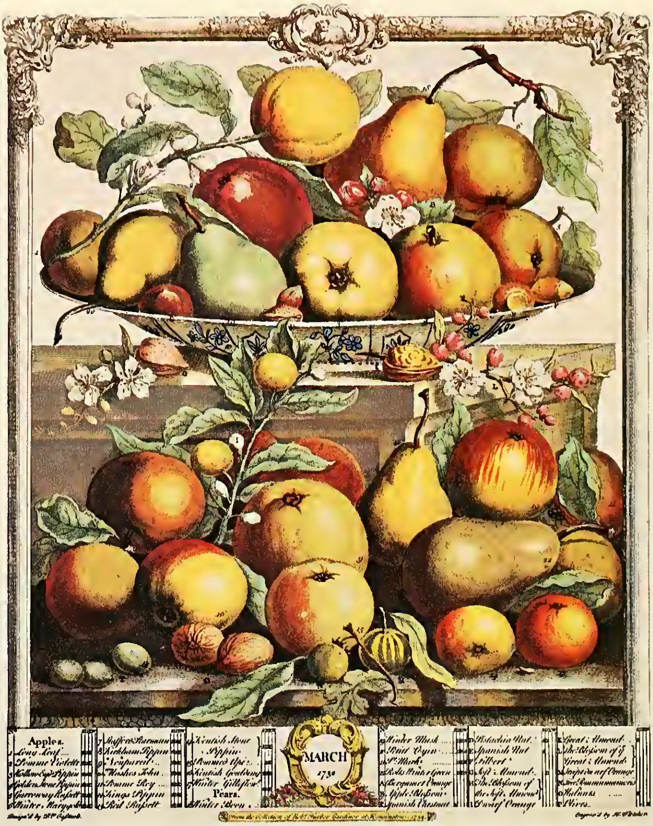
No.		SDEW
	Apples.	
1	Kernel Pearmain	SDE
2	Green Reinette	SDE
3	Yellow Reinette	SDE
4	Harvey Pippin	SDE
5	Great Gold. Russett	SDE
6	St. Francis	SDE
7	Russett Pearmain	SDE
8	Golden Pippin	SDE
9	Carolina	SDE
10	White Ice	SDE
11	Loans Pearmain	SDE
	Pears.	
12	Best Chaumontel	DES
13	Sheppard's Golden Bell	DES
14	Winter Catherine	DEE
15	Royal D'Hyver	DEW
16	Winter Lemon	SDE
17	Golden Boon	DEE
18	St. Germain from a Dwarf	SDE
19	Capon D'Hyver	DES
20	Winterthorn	DEE
21	Lemmintons Chaumontel	DES
22	Louise Boon	DES
23	Muscat Almaine	DEE
24	Petit Boon	DES
A	Bonnell hard Rose	
B	The Yellow Berried Holly	S
C	Winter Crack	SD
D	Italian Privett	S
E	Cockspurthorn	S
F	Yellow Azarole	SD

JANUARY
1732

Design'd by Pt. Casteels.

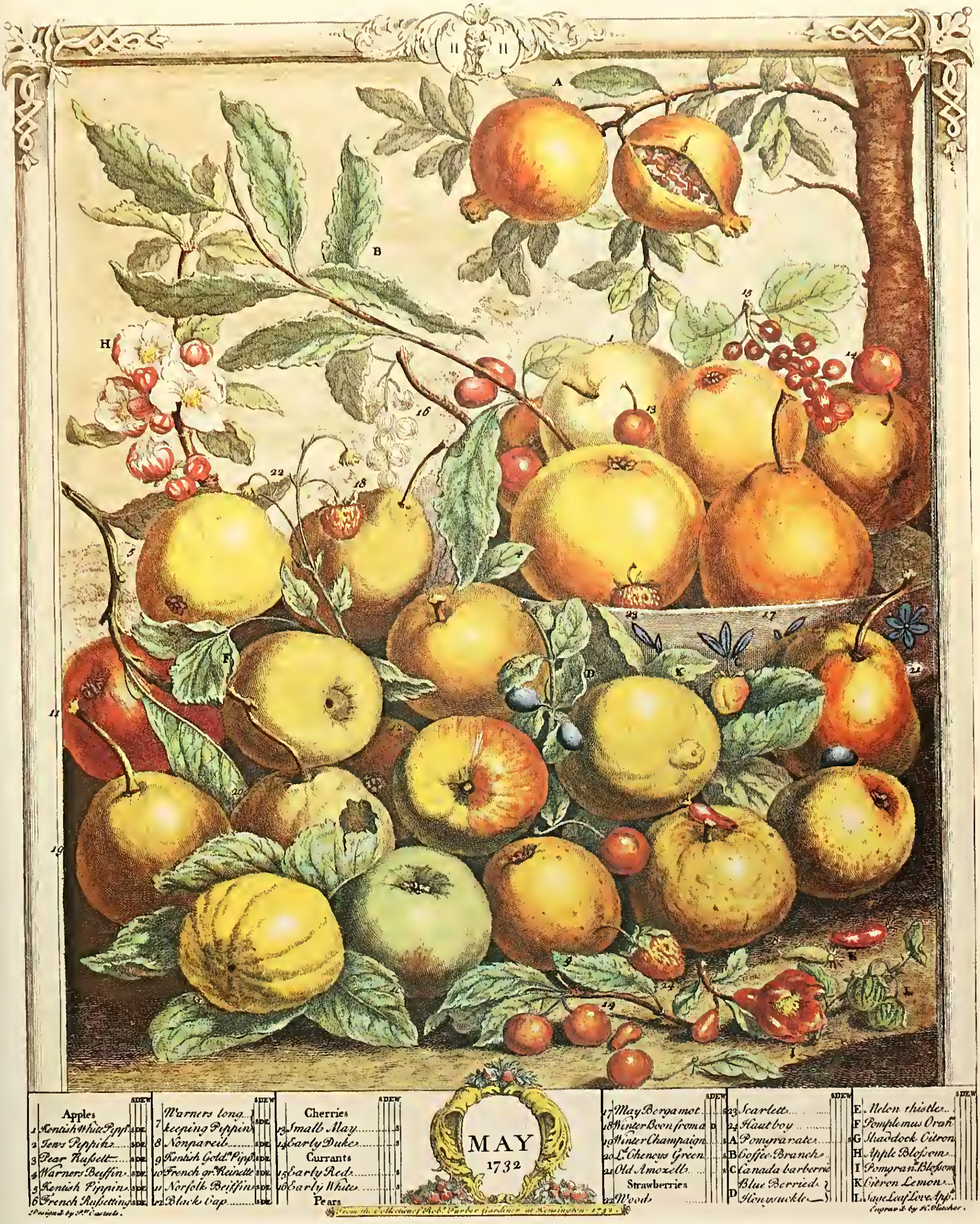
From the Collection of Robt. Furber Gardiner at Kensington 1732.

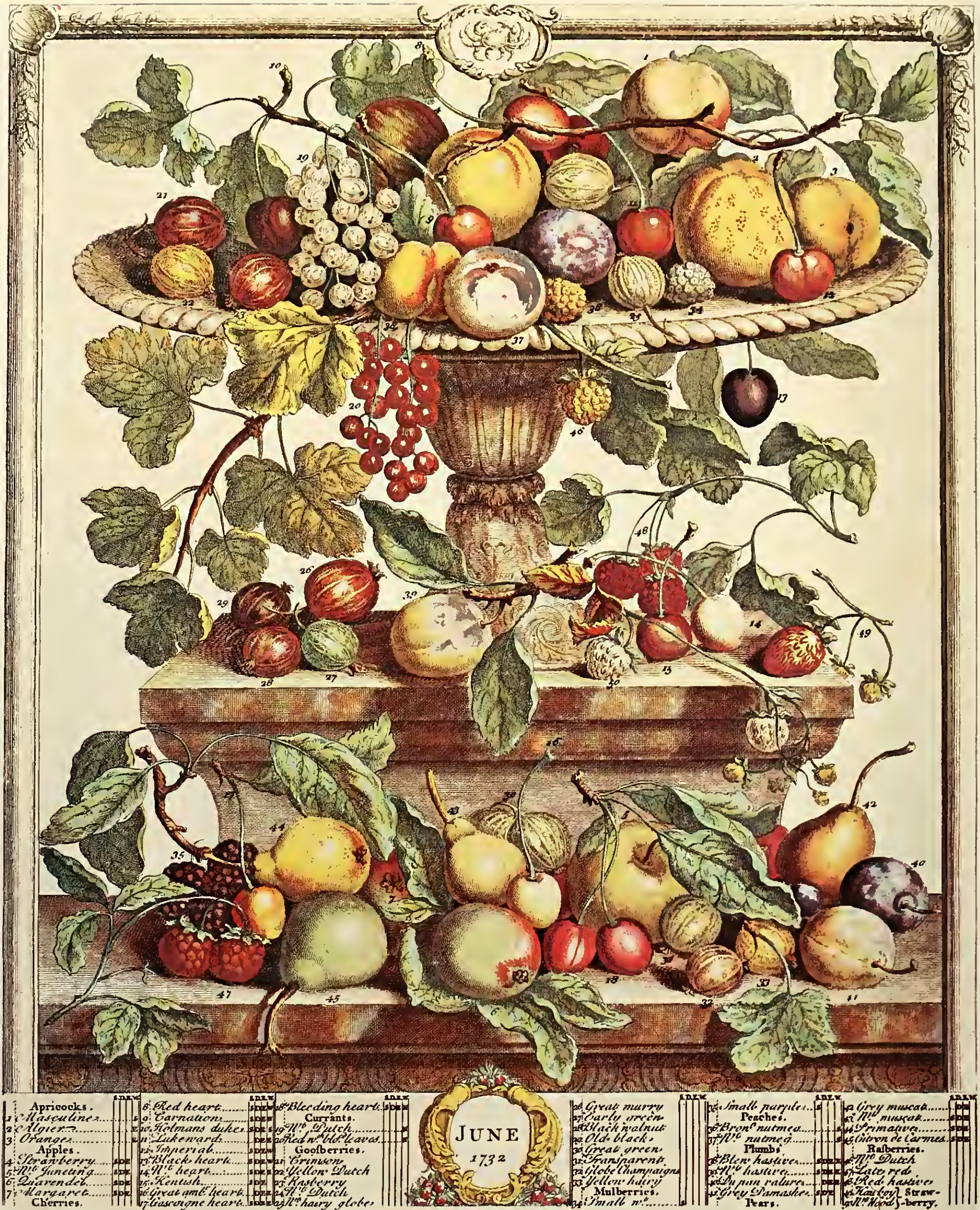
Engrav'd by G. Vandergucht.


Apples.
Long Leaf
Pomme Violette
Golden Stone Pippin
Winter Marygold
Kirkham Pippin
Nonpareil
Pomme Roy
Kings Pippin
Red Russet
Kentish Stone Pippin
Kentish Goldring
Winter Gillyflower
Pears.
Winter Boon
Winter Musk
St. Mark
Bergamot Orange
Apple Blossom
Spanish Chestnut
Pistachio Nut
Spanish Nut
Filbert
Soft Almond
The Blossom of the Soft Almond
Dwarf Orange
Great Almond
The Blossom of the Great Almond
Walnuts
Vines
MARCH
1730

The accompanying engravings are part of a series, Twelve Months of Fruits, *London, 1732. Produced by Robert Furber, a nurseryman from Kensington, the set was a kind of seed catalog for his wealthy clientele, which included the royal family. Each plate, labeled by month with the appropriate sign of the zodiac at the top, depicts the fruits that ripen approximately during that month. The fruits are keyed—by number for common species and by letter for the more unusual—and variety is indicated by S (Standard), D (Dwarf), E (Espalier), and W (Wall). The best exposure for wall varieties is given by the initial letter of the compass point.*

COURTESY PIERPONT MORGAN LIBRARY


Apples
1 Kentish White Pipp.ⁿ SDE
2 Jews Pippin SDE
3 Pear Russett SDE
4 Warners Beffin SDE
5 Kentish Pippin SDE
6 French Russetting SDE
Warners long keeping Pippin SDE
7
8 Nonpareil SDE
9 Kentish Gold.ⁿ Pipp. SDE
10 French gr. Reinette SDE
11 Norfolk Beiffin SDE
12 Black Cap SDE
Cherries
13 Small May S
14 Early Duke S
Currants
15 Early Red S
16 Early White S
Pears
MAY
1732
17 May Bergamot
18 Winter Boon froma D
19 Winter Champaign
20 Lᵈ Chenеys Green
21 Old Amozell
Strawberries
22 Wood
23 Scarlett
24 Hautboy
A Pomgranate
B Coffee Branch
C Canada barberrie
D Blue Berried Honeysuckle
E Melon thistle
F Pomplemus Oran.
G Shaddock Citron
H Apple Blossom
I Pomgran. Blossom
K Citron Lemon
L Sage Leaf Love App.
SDEW
Design'd by Pᵗʳ Casteels.
From the Collection of Robᵗ Furber Gardiner at Kensington 1732.
Engrav'd by H. Fletcher.



Apricocks.
1 Masculine
2 Algier
3 Orange
Apples.
4 Strawberry
5 Wh.t Juneting
6 Quarendel
7 Margaret
Cherries.
8 Red heart
9 Carnation
10 Holmans duke
11 Lukeward
12 Imperial
13 Black heart
14 Wt. heart
15 Kentish
16 Great amb.r heart
17 Gascoigne heart
18 Bleeding heart
Currants.
19 Wh.t Dutch
20 Red w.th bl.d leaves
Goosberries.
21 Crimson
22 Yellow Dutch
23 Rasberry
24 Wh.t Dutch
25 Wt. hairy globe
26 Great murry
27 Early green
28 Black walnut
29 Old black
30 Great green
31 Transparent
32 Globe Champaign
33 Yellow hairy
Mulberries.
34 Small wt.
35 Small purple
Peaches.
36 Bron.e nutmeg
37 Wt. nutmeg
Plumbs
38 Blew hastive
39 Wt. hastive
40 Du pin valure
41 Grey Damaske
Pears.
42 Grey muscat
43 Wt. muscat
44 Primative
45 Citron de Carmes
Rasberries.
46 Wt. Dutch
47 Late red
48 Red hastive
49 Hautboy } Straw-
50 Wt. Wood } -berry.

JUNE
1732

Design'd by P.tr Casteels.

From the Collection of Rob.t Furber Gardiner at Kensington 1732

Engrav'd by H. Fletcher

misshapen appearance. If the disease strikes late in the year, the damage to the apple skin does not injure the flesh inside and the fruit can still be eaten.

Weather conditions can also reduce an apple crop. Late summer hail storms are especially damaging, as are strong winds, which whip the apples into the branches, causing bruises and scratches.

> *August 28:* The apples are almost full sized and have begun to lose their surface chlorophyll. The Red Delicious apples show signs of coloration. The farm crew is picking some of the summer apple varieties in the variety plot.

The apples reach full size about one month before harvest, but are still green, firm, and filled with starch. In response to an internal (genetic and hormonal) timing mechanism, a special layer of cells forms across the base of the apple stem, gradually cutting off the import of additional nutrients from the leaves. From now until it is ready to fall from the tree, the apple is on its own, and to maintain its life processes, it must produce its own energy. To do so, the apple converts its stored starch into sugars, which are then used in cell respiration to produce energy.

When picked, an apple is sweet because of the sugars it has converted from starch. Its tartness comes from the acids, especially malic acid, involved in respiration metabolism.

During this last month on the tree the apple develops its characteristic coloration. Just as the pigmentation of autumn leaves signals their decline, the coloration of the apple skin marks the approach of the fruit's decay and death. The same pigments are responsible for the colorations: carotene, which causes the leaves of birch, tulip, and poplar trees to turn bright yellow, is the main pigment in yellow apple varieties; red varieties derive their coloration from anthocyanin, as do pin oak, scarlet oak, and sweet gum leaves. Since the production of anthocyanin in the apple skin requires sunlight, especially the shorter ultraviolet rays, cloudy or overcast days in September will reduce the coloration of red apples.

> *September 23:* Today's leaf samples show greatly reduced protein levels. The brightly colored apples hang in great profusion among the full foliage. A large number of apples have already fallen to the ground, where squirrels and other small animals are gathering their fill. Many of those on the tree have been eaten by birds.

As much as humans delight in the taste of a juicy, crisp apple, the apple flesh exists to serve its own species. The flesh does not nourish the seeds, as such, but it does serve two basic functions for the seeds inside. First, it offers a method of transportation. When animals eat the apple flesh, they also ingest the seeds, which are later eliminated in animal droppings some distance from the original tree.

The apple flesh also protects the seeds from impromptu germination during a warm spell in winter, which would surely kill the tender seedlings. The seeds themselves possess a secondary guard against early germination—an inhibitory hormone in the seed coat. A series of freeze-thaw cycles is necessary to inactivate this hormone. By spring, the seeds are freed from their encumbrances and will germinate, other conditions being favorable.

> *October 3:* The leaves appear as green as ever, but actually they contain much less chlorophyll and protein than they did in August. The farm crew has already harvested the Jonathan apples and is working on the Red Delicious today. The Golden Delicious apples will be harvested within the next few days.

Even after it is removed from the tree, an apple is a living organism and still contains enough sugars to produce energy for many weeks. If the apple is stored at a low temperature (35° to 40°F.) with high humidity, its respiration can be slowed down. Under such conditions, it can survive for months. But eventually the supply of internal sugars runs out and with it the apple's source of energy.

The turning point in the life of the fruit, when development and maturation are complete but before deterioration begins, is called the climacteric. A marked increase in respiration and a production of ethylene gas, which characterize the climacteric are positive, vital factors in ripening. The exact causes are still unknown, but shortly after the climacteric, the apple begins to deteriorate. The acids, sugars, and pectin, among other substances, begin to decline. An overaged apple is neither as tart and crisp nor as sweet as a ripe apple. Finally, the cells in the flesh collapse, leaving the strong cell walls in place, which is what causes an overaged apple to feel and taste "mealy."

> *October 20:* I collected what might be the last or next-to-last leaf sample, that is, if the first frost comes at its usual time. All the apples have been harvested, leaving the trees bare. Since its leaves have no autumn coloration but just fade and turn brown, an apple tree without its fruit or blossoms is plain and unspectacular.

Soon after the first frost, the apple leaves wither, dry, and fall from the tree. Since early August the leaves have been steadily losing their protein and nitrogen. The nitrogen is transported back to the tree for storage over the winter. In the spring, when the first blossom and leaf buds break their dormancy, this supply of stored nitrogen (as well as carbohydrates) will furnish the food and energy required for their growth. And so the process will start again, this fall's dying leaves insuring next season's flowers and fruits. □

Precarious Odyssey of an Unconquered Parasite

With the creation of each new irrigation ditch in tropical regions, schistosomiasis may infect more people

by Kenneth S. Warren

Most of us have seen Tarzan swimming frantically through tropical waters in an attempt to escape a huge man-eating crocodile. What we do not see are the minute, fork-tailed worm larvae boring their way through his skin. These freshwater organisms develop into worms called schistosomes, or blood flukes. The inch-long adult worms live in the blood vessels of the intestines and the urinary tract—hence in Chinese they are called 血吸虫, or blood-sucking worms. Schistosomiasis is now considered to be the greatest unconquered parasitic disease afflicting humans and animals in the tropics and subtropics.

While Tarzan lives in trees and only occasionally enters the water, most people living in the tropics have to come into daily contact with bodies of fresh water for sustenance, work, and play. As a result, more than 200 million people in Asia, Africa, South America, and the Caribbean are presently infected with one or even two of the three species of schistosomes that infect human beings.

These organisms are members of the phylum Platyhelminthes (flatworms) and the class Trematoda. The German pathologist Theodor Bilharz discovered schistosomes while performing an autopsy in Cairo. In 1852, he described this startling experience as follows: "After my attention had been drawn to the liver and its connections, I soon found a white long helminth in the blood of the portal vein . . . which I immediately recognized as something new. The microscope revealed a splendid distomum [worm with two mouths] with a flat body and a curving tail." Bilharz called the parasite *Distomum haematobia*, but within a few years two parasitologists, Weinland in Germany and Cobbold in England, realized that the organism did not have two mouths (*stoma*), but that one opening was an oral cavity and the other was a sucker.

In 1858 Weinland suggested the name *Schistosoma* referring to the cleft (*schistos*) body (*soma*) of the male worm. Only three months later Cobbold suggested *Bilharzia* to honor the discoverer of the parasite. Although Weinland was willing to defer to this fine gesture, the rules of nomenclature required adoption of the first valid name appearing in the literature—*Schistosoma*. Nevertheless, the infection is still called bilharziasis in many parts of the world. The worm with the cleft body is the male, and within the cleft lies the long, thin female.

There are three major species of schistosomes that develop to maturity in man: *Schistosoma japonicum* of the Far East (China, Japan, and the Philippines); *S. haematobium* of Africa and the Middle East; and *S. mansoni* of Africa, South America (Brazil, Venezuela, and the Guianas), and some of the islands of the Caribbean, notably Puerto Rico.

Schistosomes fall into a unique class of parasitic flatworms called trematodes, all of which have life cycles involving snails as intermediate hosts. The adult schistosome worms living in the veins of the intestines and the urinary bladder of man produce large numbers of eggs. Many of the eggs work their way out of the blood vessels and through the tissues of the intestines or bladder, leaving the body in the feces or urine. The eggs begin to hatch within minutes of entering fresh water, and the tiny ciliated miracidia (free-swimming larvae) begin to swim rapidly about. After finding and penetrating a snail of the proper species, they grow through three different developmental stages, multiplying to an enormous degree.

About a month later, snails with *S. mansoni* or *S. haematobium* infections begin to shed thousands of tiny fork-tailed cercariae, or second-stage larvae (about one-tenth of an inch in length), each day for many months. These cercariae move about in the water by wriggling their tails. In contrast, *S. japonicum* cercariae are produced at a rate of only one or two a day and remain relatively quiescent on the surface film of the water.

When they come into contact with humans or other animals the cercariae attach themselves to the skin with their suckers and bore into the body: *S. mansoni* does so in about three minutes; *S. japonicum* as quickly as thirty seconds. The tail is left behind, and in the process of penetration the head of the cercaria undergoes a profound

Once a week, St. Lucians carry bananas to the docks. There is little danger that these people will develop schistosomiasis, for as soon as they cross the stream, their feet will quickly dry and any larvae on them will die.

TEO SPIEGEL, THE ROCKEFELLER FOUNDATION

metamorphosis from a freshwater animal to a schistosomule, or young schistosome, which can exist in the salty environment of the blood.

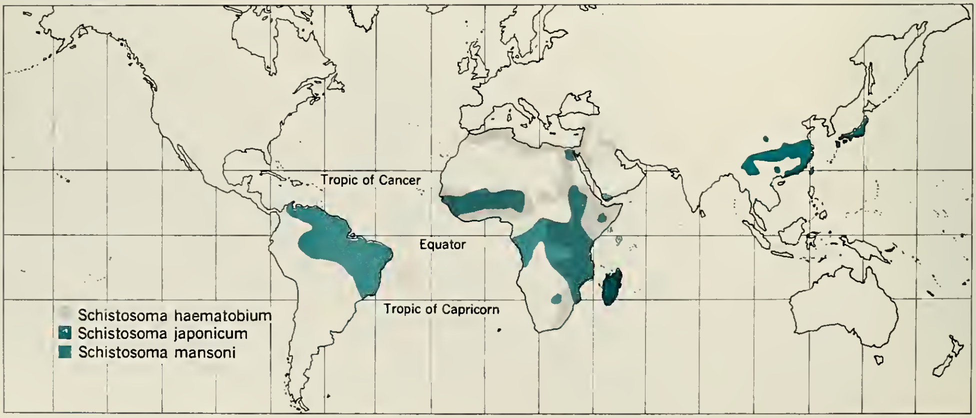
The geographic distribution of any schistosome species is strictly related to the presence of susceptible snail species; the life cycle cannot continue in areas where such snails are not found. Thus while both *S. haematobium* and *S. mansoni* undoubtedly came to the New World with the slave trade, the former did not become established because there were no host snails. The life cycle of *S. mansoni* developed only in areas where susceptible snails existed; the parasite is highly endemic on the West Indian island of St. Lucia but has never been encountered on the island of St. Vincent only thirty miles away.

Many people migrating to the continental United States are infected with schistosomiasis, including approximately 10 percent of the 1.5 million resident Puerto Ricans and an unknown proportion of 100,000 annual immigrants from other endemic areas. Fortunately, a susceptible species of snail has been encountered only once in the continental United States, and that was in a swamp in Louisiana during World War II. Extensive search since then has never uncovered either these snails or any other susceptible species.

The life cycle of the schistosomes is fascinating because the parasites reproduce asexually in the snail and sexually in the human. When one miracidium, freshly hatched from a schistosome egg, penetrates a snail, it will multiply asexually into more than 100,000 cercariae of similar size. So many cercariae develop that they virtually replace the digestive glands of the snail, resulting in a high snail mortality. In contrast, each cercaria that penetrates a human develops into only one worm.

When the male and female worms mate in the human body, they do not replicate, but instead produce large numbers of eggs that must leave the body, hatch, and enter a snail in order to continue the reproductive process. Infected humans carry different worm burdens, and depending largely on their degree of contact with water and the number of cercariae that penetrate the skin and develop to maturity, they may accumulate high levels of worms. Once in the body, these organisms live for five to ten years, and some may live as long as thirty years. Nevertheless, the majority of people in most endemic areas have relatively low worm loads. Only a small proportion of individuals bear heavy worm burdens, and it is these people who are most likely to develop fatal disease.

Emission of Schistosoma mansoni *larvae is stimulated by light and peaks during the middle of the day. Since children usually swim during this time of day, they are very likely to become infected.*



TED SPIEGEL, THE ROCKEFELLER FOUNDATION

Considering the differences in the infectious process in man and the snail, what is the ecological relationship between these two hosts in relation to schistosome infections? Both the number of eggs excreted by man and the site of their deposition are important factors. Many infected individuals emit only 100 eggs per day, while some people may excrete more than 500,000 eggs daily. Feces deposited on land will do no harm unless washed into water by heavy rains. The most advantageous situation for maintaining the life cycle is passage of feces directly into an aquatic environment rich in vegetation, which is a good habitat for snail breeding.

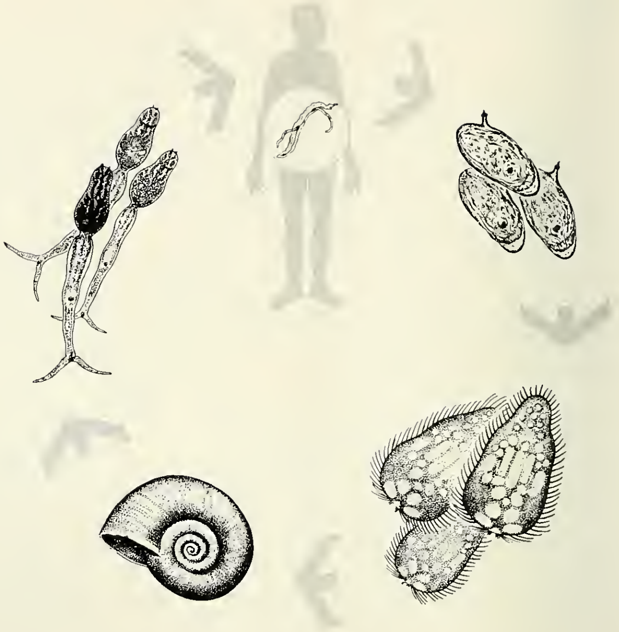
Children swimming in streams often defecate or urinate in the water as do women washing clothes or men working in the fields. In Muslim countries the religious necessity for ablutions after defecation and before prayer is a significant factor in the spread of infection. In Yemen infected snails were found in ablution fonts within mosques. The entire problem could be solved by regular use of latrines, but in many cases when sanitary facilities have been constructed, people have not always used them. For example, human feces are a major food source for pigs on the Philippine island of Leyte. When latrines were constructed the animals began to starve, so the sanitary facilities were abandoned.

Three ways of quantifying the degree of infection in tropical waters have been developed: first, miracidia are detected by the infection of laboratory-reared "sentinel snails" immersed in bodies of water in wire mesh cages; second, free snails are dredged up and examined for natural infection; and third, cercariae are detected either by floating partially immersed "sentinel mice" on the water or by special filtering devices.

A very small proportion of miracidia reach and infect susceptible snails under natural conditions. Only one-half of one percent of 50,000 snails collected on the island of St. Lucia over a period of two and a half years were infected. In contrast, 30 percent of the human population was infected. In Egypt, where both *S. mansoni* and *S. haematobium* are highly endemic in man, the rate of infection of snails with *S. mansoni* was similar to that on St. Lucia, and with *S. haematobium* it was even lower. There are habitats, however, with high concentrations of infected snails, where exposure may result in severe infections in humans.

Levels of cercariae in most bodies of water are usually very low, for example, fewer than one per quart in a heavily infested area of St. Lucia. There are also marked diurnal variations in the numbers of cercariae present in the water. The emission of *S. mansoni* cercariae is stimulated by light, and peak output occurs between 11:00 A.M. and 1:00 P.M. As most cercariae remain infective for only a few hours, the chances of infection are quite low in the evening and unlikely in the early morning. Interestingly, peak

LIFE CYCLE OF *Schistosoma mansoni*



Schistosomiasis can only occur with the appropriate interaction of water, snails, and man. When S. mansoni eggs, which are carried in human feces or urine, enter fresh water, they hatch into ciliated miracidia within minutes, then find and penetrate the proper snail species. There, each miracidium produces more than 100,000 cercariae (larvae), which often crowd out the snail's internal organs, killing it. After a month, the cercariae begin to leave the snail. Upon contact with a person in water, a cercaria bores into the body in three minutes and metamorphoses into a schistosomule (young worm). The young worms then migrate via the circulatory system to the lungs, where they undergo some development, then pass to the liver, where they mature and mate—the female entering the cleft in the male's body and remaining there for life. The couple then migrate to the intestines, where they produce about 300 eggs per day during their entire life-span, which may last up to thirty years. More than half the eggs remain in the intestines and the liver, but the rest are expelled in the feces, renewing the cycle.

output of *S. japonicum* cercariae occurs in the evening.

While merely being splashed with water in endemic areas has been considered to be very dangerous, the actualities suggest that this is not so. To take an extreme example, children who wade rapidly across a fast-flowing shallow stream away from human habitation early in the morning on their way to school will probably not become infected. Water contact resulting in infection is related to a number of factors, including location and time of day as well as frequency and duration of exposure.

Studies in endemic areas of Puerto Rico, Egypt, Rhodesia, and St. Lucia have shown that between 50 and 85 percent of water contact is related to play activity of children and teen-agers. A close correlation of age, water contact, and prevalence of infection has been demonstrated in St. Lucia.

The interrelation between man and the snail has been described in a mathematical model. This relationship helps explain why the prevalence of infection in snails that are immersed in water twenty-four hours a day is very low in the presence of a high infection rate in man, who has only sporadic water contact. First, snails are relatively short-lived; under the best of circumstances, they have a life-span of only several months. Moreover, schistosomiasis is usually lethal to snails, as the multiplication of one miracidium into hundreds of thousands of cercariae destroys a snail's internal organs. These factors, combined with the usual dispersion of snails in large volumes of water or in rapidly flowing streams, tend to keep infection levels low.

In contrast, man is long-lived; the worms within man have relatively long life-spans, and these parasites do not multiply. An individual with a single male and female worm will thus have eggs in his feces, and consequently a detectable infection, for a decade or more. Only a small proportion of people with schistosomiasis have infections heavy enough to result in overt disease, and in even fewer is death directly attributable to the infection.

When looked at in this way, the

low prevalence and high intensity of infection in the snails in comparison with the high prevalence and low intensity of infection in man becomes explicable.

This viewpoint, suggesting that ecology is the major factor controlling the prevalence and intensity of schistosomiasis, conflicts with the more traditional viewpoint, which is that immunity is the controlling factor. The immunity concept has been well expressed by Dr. Margaret A. Stirewalt, one of the great experts in this field, who writes, "Clinical data from human infections . . . give almost irrefutable evidence of man's acquired immunity. The fact that man lives at all under conditions of constant reexposure such as those experienced by the Egyptian felaheen and the rice farmers of the Orient who have been in almost daily contact with cercariae-containing water since childhood, surely indicates an acquired resistance to reinfection."

It is very unlikely, however, that people are in constant contact with infective waters from childhood to old age. There is no definitive proof that immunity to schistosomiasis occurs in man, and its occurrence in different species of experimental animals, both rodents and primates, tends to be partial and sporadic. It is probable, however, that partial immunity occurs in areas where, and under conditions in which, transmission is heavy.

One question invariably asked about schistosomiasis is, What does this infection do to people? Studies of field populations over the past several decades have revealed little or no effect on the mental ability of children or the work output of adults. Recent studies of St. Lucian children and adult Yemeni immigrants in the San Joaquin Valley of California have shown relatively few symptoms of infection even in those with heavy worm burdens. But when individuals from large infected populations are filtered out in hospitals, many severe and potentially fatal infections are revealed.

To understand how the parasite produces disease, the host-parasite relationship must be examined. The schistosomules migrate from the skin via the circulatory system to the lungs, where they pause to undergo a minor degree of development. They then pass to the liver either through the bloodstream or the tissues. In the liver, the worms grow considerably in size, and the males and females mate, the female entering the cleft in the male's body and apparently remaining there for life. The couples then migrate, against the blood flow, from the liver to their final habitats—the veins of the small intestines for *S. japonicum*, of the large intestines for *S. mansoni*, or of the urinary bladder for *S. haematobium*—and begin to deposit eggs.

The entire process from skin penetration to oviposition takes three to ten weeks, depending on the species of schistosomes. Investigators have wondered why these relatively large foreign organisms in the bloodstream neither initiate blood clotting nor elicit immunological reactions. Although the first query is unanswered, recent work has shown that the surfaces of the worms become coated with materials from the host, thereby disguising them from the immunological surveillance systems of the body.

The worms may live for as long as thirty years, as demonstrated by the presence of living eggs in the feces of patients who have left endemic areas. Epidemiological evidence suggests, however, that the mean life-span of schistosomes varies from five to ten years, during which time the worms continue to produce large numbers of eggs.

The human body reacts to the various schistosome stages in a number of different ways. During penetration of the skin by the cercariae, a mild, prickly sensation is felt. If there are frequent exposures, allergic sensitization may occur, leading to mild local swelling and redness immediately after the penetration of cercariae, followed in six to twenty-four hours by an intensely itchy skin rash. Although this syndrome may occur with all three schistosomes of man, it is more common and severe when avian or animal cercariae penetrate human skin. Since these organisms cannot develop further in man, all die in the skin. The severe skin rash produced in man by schistosomes that do not infect humans is called swimmer's itch and is found all over the world.

The next phase of infection with the human-infecting schistosomes is highly distinctive, but occurs in only a small proportion of individuals—those who become heavily infected on first exposure to the parasite. The disease syndrome is often called acute schistosomiasis, but is better known as Katayama fever, after a prefecture of Japan where one of the earliest descriptions of schistosomiasis was recorded. This paper, published in 1847, begins, "In the district of Kawanami . . . there are two hills amidst rice fields. One is called Ikariyama, and the other is called Katayama. The latter is also called Urushiyama [Lacquer Mountain]. According to an old legend, a merchant ship full of lacquer came along and anchored. It happened that a storm came and the ship capsized. The name Urushiyama originated from this story, and the tradition says that all people passing by this hill had skin irritation due to lacquer." The author went on to describe the disease further, and the name Katayama fever caught on in the Far East.

About the turn of the twentieth century a syndrome typical of this disease was particularly well described in British sportsmen who hunted in the rice paddies along the Yangtze River. It is typical of Katayama fever as we see it today. Symptoms (fever, chills, headache, diarrhea, and cough) begin twenty to sixty days after exposure to highly infective waters. This reaction occurs about the time that the schistosomes reach maturity and begin to deposit eggs. Enlargement of the liver, spleen, and lymph glands is frequent and eosinophilia occurs in many cases. Eosinophils are white blood cells whose granules take up the red stain eosin; diagnostically they act as a red flag suggesting infection by one of several different species of worms. The fever may last for several weeks, and when it subsides the other signs and symptoms go with it. Katayama fever occurs in relatively few of those infected with human schistosomes, but appears most frequently and with perhaps the greatest severity in

S. japonicum infections, when it may be fatal.

When this phase of the infection subsides, all signs and symptoms of schistosomiasis may disappear for many years, but some patients infected with *S. japonicum* or *S. mansoni* have intermittent diarrhea or dysentery, and some with *S. haematobia* have bloody urine, referred to as hematuria. Hematuria is so common in some parts of Africa that a child at puberty passing urine free of blood is considered to be abnormal.

During this long and usually quiescent period, the small proportion of individuals with heavy infections may be undergoing insidious damage until chronic, irreversible disease suddenly appears. Infections with *S. mansoni* and *S. japonicum* may cause the patient to vomit as much as a quart of blood, and *S. haematobia* may cause him to sink into a coma as his kidney function falls below acceptable limits. These severe disease states result because each pair of schistosome worms produces eggs at a rate of 300 to 3,000 per day over their entire life span. While many of the eggs pass out of the body, at least half of them remain in the tissues of the intestines, urinary bladder, and ureters. In addition, large numbers of eggs become loose in the intestinal veins and pass up into the liver, where they are trapped as the blood vessels narrow down again. Thus, over a period of ten years, an individual carrying 100 *S. japonicum* worm pairs will retain about one-half billion eggs in his tissues.

In contrast to the body's lack of reaction to worms, the eggs are violently attacked by the host's white blood cells (phagocytes). This attack, now known to be an immunological reaction, leads to marked local tissue destruction and scarring.

Small numbers of eggs cause little or no permanent damage, but large numbers may lead to the extensive formation of fibrous tissue, impeding the flow of blood through the liver or of urine through the bladder. In the former case, as the intestinal circulation passes through the obstructed liver there is a marked increase in blood pressure, the veins along the upper stomach or the esophagus may become enormously dilated and burst, and the patient may bleed to death.

In the latter case, the flow of urine from the kidneys to the bladder may be blocked by fibrosis of the ureters resulting in urinary back pressure and enlargement and destruction of the kidneys. There is also an increased incidence of cancer of the bladder in persons who have urinary schistosomiasis. Death of the host, however, means destruction of the parasite, and with schistosomes, as with other well-adapted parasitic organisms, host mortality is low, and reasonably healthy people continue to excrete eggs, thus maintaining the life cycle.

Less commonly, the lungs and central nervous system may be harmed by the schistosomes. Severe lung damage usually develops only after the flood flow through the liver has been significantly impaired. Enlargement of previously small veins permits the blood to bypass the liver; eggs are then carried around the liver and into the systemic circulation, where they are filtered out in the lungs. The eggs incite inflammation followed by fibrosis, and circulation through the lungs is blocked. The heart, continuing to pump blood through the lungs against ever increasing pressure, enlarges and may then fail.

Damage to the central nervous system is apparently due to worm pairs that occasionally enter the brain or spinal cord and produce large deposits of eggs. For unknown reasons, *S. japonicum* tends to localize in the brain, causing signs and symptoms of brain tumors and epilepsy, while *S. mansoni* and *S. haematobium* are usually found in the spinal cord and induce paralysis of the limbs.

Since there has been no strong evidence for immunity in man, little has been done to try to develop a vaccine to prevent schistosomiasis. Tartar emetic, an intensely toxic drug, has been a staple for treating this infection ever since its efficacy was discovered in 1916 in Khartoum. As a therapy for schistosomiasis, it must be administered intravenously every other day for a month. It causes vomiting, severe cough, and cardiac damage, which may result in sudden death. Some promising intramuscular and oral agents have appeared, but all of them cause a variety of unpleasant side effects. One of the best new drugs, highly effective in a single intramuscular injection, unfortunately has been implicated as a cancer-producing substance.

Although schistosomiasis is still common on St. Lucia, its incidence is decreasing owing to the islanders' efforts to avoid infection. One precaution is to boil water before bathing.

Some means of attacking and destroying the cercariae and miracidia in their passage between snails and humans have been devised. They include larva-eating guppies, carnivorous water plants (*Utricularia*, or bladderwort), and nonsusceptible snail species, which attract miracidia and thereby interfere with normal transmission. Another approach would be to prevent infection in snails either by the development of adequate human sanitation or by means of mass treatment of infected people. If snails become infected they can actually be cured by drugs, but the major means of controlling schistosomiasis has been the use of molluscicides to kill all snails. This is analogous to the use of insecticides; here too the final result may be the development of silent springs—and rivers and lakes.

Biological control of snails has also been advocated and involves predators such as bigger snails, insects, fish, turtles, and ducks, or parasites such as bacteria, viruses, and other worm larvae. Unfortunately, none of these methods has proved to be practicable on a mass scale. The present-day symbol of schistosomiasis, therefore, remains the great high dam at Aswan, which will irrigate millions of square miles of Egypt and cause millions of new infections with the blood fluke. ☐

TED SPIEGEL, THE ROCKEFELLER FOUNDATI

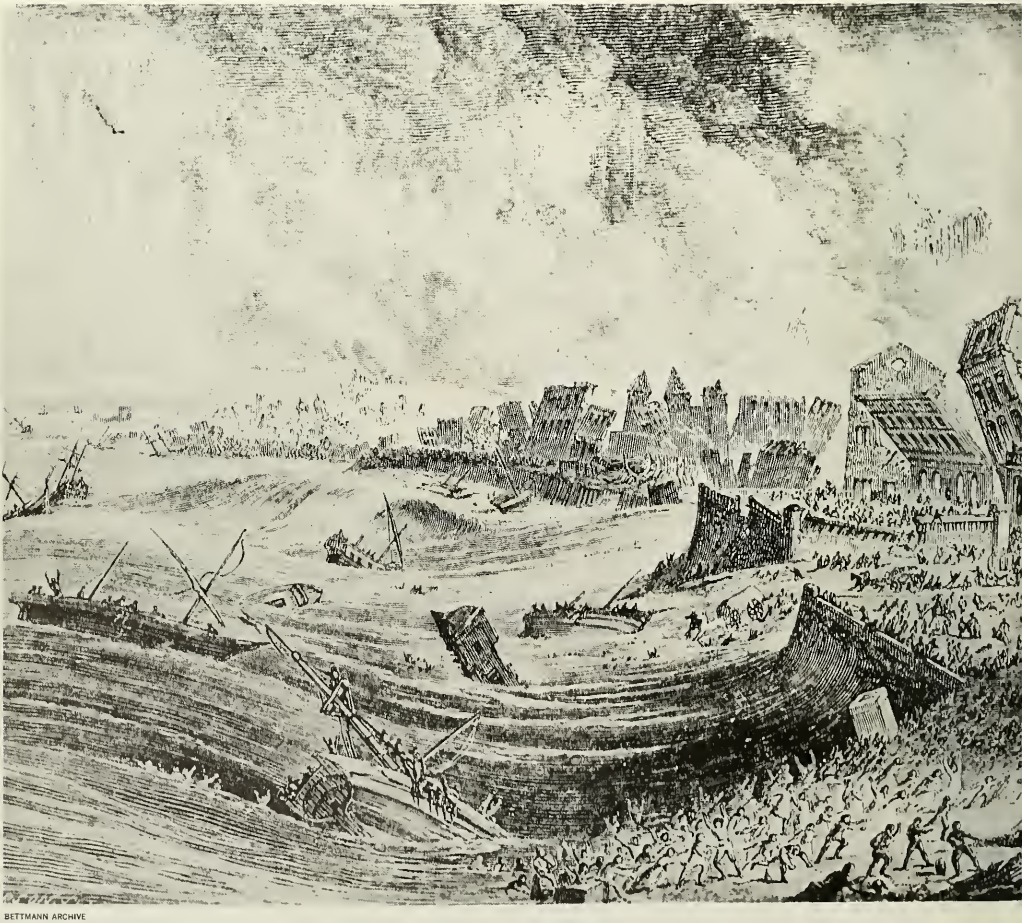
Toward Infallible Earthquake

Within about five years it may be possible to learn in advance the time, place, and size of many major shocks

by Christopher H. Scholtz

Major earthquakes are among nature's most devastating events. They have caused an incalculable loss of life and property. Because accurate earthquake prediction has long been a highly desired goal, seismology has always been beset by those who claim the ability to predict earthquakes, most often on psychic or other nonphysical grounds. Although such claimants are commonly cranks or charlatans, they have received considerable public attention in earthquake-prone areas. It is only within the last ten years that our greatly expanded knowledge of the mechanism and cause of earthquakes has made earthquake prediction a reputable field for scientific research.

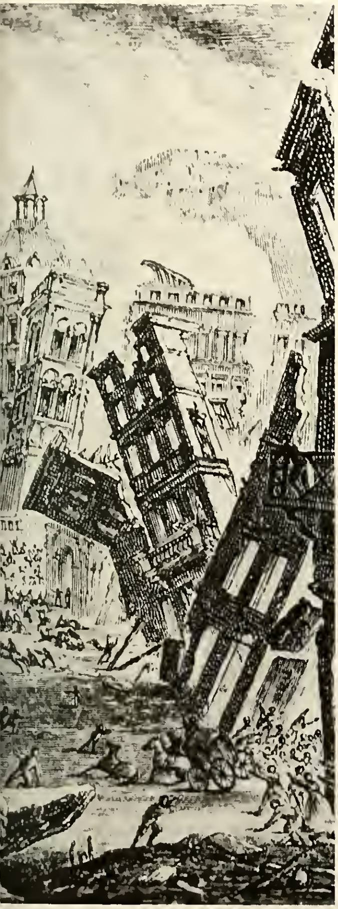
It was natural that the lead in earthquake prediction should come from Japan. The science of seismology has always been very advanced in that country, which has perhaps the greatest seismic hazard in the world. In the early 1960s the



BETTMANN ARCHIVE

Prediction

Japanese took on the challenge and initiated a national research program. Several years later the Soviet Union began a similar national program. Although the United States has never had such a specified earthquake prediction research program, scattered research on the subject began in this country concurrently with the Russian effort.



One of the greatest earthquakes on record devastated Lisbon in 1755. Most of the buildings in the city collapsed, and an estimated 60,000 persons perished. The shock was felt all over Portugal and Spain and as far away as southern France and the north of Africa. The disturbed area probably encompassed more than one million square miles. The earthquake came without any warning. Seismologists today say that a quake of such magnitude can probably be predicted several years in advance.

The obstacles to making earthquake prediction a reality are formidable. The problem was succinctly stated as long ago as 1935 in an article in *Science:*

> Unless and until such prediction can be reduced to a very precise procedure, giving time, place, and magnitude reliably and almost infallibly, the public announcement of the prediction is likely to be harmful and mischievous.

According to that forty-year-old warning, earthquake prediction will not be useful if it simply consists of making educated guesses about whether the probability of an earthquake is high or low in various places. Based on inductive reasoning from past experience, such guesses can be made, and they are useful for planning purposes, but they are not earthquake prediction per se. For example, Managua, Nicaragua, has been devastated three times by earthquakes at forty-year intervals, and this knowledge will influence decisions about rebuilding the present city. If earthquake prediction of the type described in the *Science* article had been available before 1972, however, much property damage and many fatalities could have been avoided in the disastrous quake that destroyed the city that year. The difficulty with earthquake prediction is, of course, the requirement of preciseness and near infallibility, which rules out the statistical method of prediction used in many aspects of weather forecasting. Earthquake prediction requires an intimate knowledge of how an earthquake works.

The forces that give rise to earthquakes are produced when vast plates of the earth's hard outer shell, or lithosphere, move with respect to one another as a result of thermal convection in the earth's less rigid, hot interior. Known as continental drift, or sea floor spreading, this process shifts the plates at steady rates of a few inches per year. Wherever two plates rub together, earthquakes occur. Under the temperature and pressure conditions of the upper part of the earth's crust, rock exhibits a type of frictional sliding known as stick-slip, an action accomplished as a series of rapid jerks interspersed with periods of sticking, or no movement. An earthquake is simply one of the jerks as the boundary between plates gives way under the inexorable movement of the earth's crust. The boundary of the plates is usually a major fault, or fracture, in the lithosphere, and most major quakes take place along those faults.

Earthquakes range enormously

in size, from small tremors in which a slip of a few tenths of an inch occurs along a few feet of fault, to the largest shocks, which may involve tens of feet of slip along hundreds of miles of fault. The velocity at which the two sides of the fault move during an earthquake is only one to ten miles per hour, but the rupture front spreads along the fault at a velocity of nearly 5,000 miles per hour. Accelerations near the focus of the shock may be as high as 1 *g*, the force of gravity. The earthquake's primary damage is due to the seismic waves it generates. Seismic waves are sound waves that travel through the earth, excited by the rapid movements of an earthquake. The energy radiated in seismic waves can be as great as 10^{12} calories (a calorie is the amount of heat required to raise the temperature of 1 gram of water 1°C.), and the power emitted during the few hundred seconds of movement can be as great as a billion megawatts, far greater than the power produced by the biggest electrical generators.

Because major earthquakes involve large volumes of the earth's crust, it seemed likely that a telltale sign, detectable by geophysical or other means, might occur at some time before the shock itself. If so, the detection of such a premonitory phenomenon would then provide a warning of the quake's coming. The early work in earthquake prediction research was based on this optimistic assumption.

The search for precursors during the past decade, carried out principally in Japan and the Soviet Union, has involved measuring many different physical properties in seismically active areas to find a pattern of geophysical changes prior to earthquakes. The results were surprising because of the large number of allegedly precursory phenomena reported. Anomalous changes observed before earthquakes included changes in the electrical resistivity of the earth's crust, in the local magnetic field, the velocity of seismic wave propagation, the uplift of the ground, and even in the radioactive isotope composition of deep well water. Many of the observations were fragmentary or isolated cases, or simply fortuitous, since it was not possible to set up a complete monitoring experiment without the ability to predict earthquakes. The diversity of the reported premonitory phenomena was confusing. How could such diverse phenomena all be connected to earthquakes? With so many different and isolated observations, one had to question whether they actually were precursory earthquake phenomena or whether each was due to another cause and had been connected to an earthquake by an overzealous researcher.

The most persistent observation was of precursory seismic wave velocity changes, which were repeatedly observed prior to medium-sized earthquakes by Russian seismologists working in the Garm region of the Soviet Socialist Republic of Tadzhik in Central Asia. Unlike sound in the air, sound propagating through solids travels in two different ways, each characterized by a different velocity. These two types of seismic waves are called the *P*, or pressure, wave, and the *S*, or shear, wave. In *P* waves, also known as compressional waves, particles are pushed in the same direction in which the pulse is traveling; in *S* waves, particles are shoved at right angles to the direction of the pulse. *P* waves are like the pulse that travels down a soft spring, such as the slinky toy, when the end is tapped. *S* waves are like the vibrations of a taut string when it is plucked.

One fundamental characteristic of solids is that the *P* wave travels through them about 1.75 times faster than the *S* wave. Yet what the Russians repeatedly observed in the vicinity of impending moderate-sized earthquakes was a pronounced decrease in that difference in velocities to as low as 1.6 times as fast. This difference in wave velocities began and persisted for several months prior to the quakes; then shortly before the earthquakes occurred, the velocity ratio returned to its normal value.

These startling results were first presented to American seismologists at a scientific meeting in Moscow in 1971. At the time of the meeting, a swarm of small earthquakes, which was taking place beneath Blue Mountain Lake in New York State's Adirondack Forest Preserve, was under intensive study by a group of my colleagues from Columbia University's Lamont-Doherty Geological Observatory. This earthquake swarm provided our first chance to check the Russian observations. The results were positive: each small to moderate-sized earthquake at Blue Mountain Lake was preceded by a drop in the ratio between the speeds of the *P* and *S* waves, followed by a recovery to the ratio's normal value shortly before the earthquake occurred. These phenomena matched exactly what the Russians had described, except for one thing: With the small Blue Mountain Lake earthquakes, the anomaly lasted only a few days, rather than the several months of the Russians' observations. This turned out to be an important clue for understanding what was producing such mysterious behavior.

An explanation for these precursory seismic velocity changes, worked out by the Lamont-Doherty team and arrived at independently by a Stanford University researcher, lies in a rather obscure characteristic of rock known as dilatancy. This is the property some materials have of expanding in volume when their shape or structure is altered under stress. Dilatancy was first discovered in the late nineteenth century by Osborne Reynolds, an Irish-British engineer and physicist, in connection with his studies of the qualities of granular materials. The essence of dilatancy is perhaps best illustrated by the example of wet beach sand. Anyone who has walked along the thoroughly wet, but not flooded, part of a beach near the water's edge has probably noticed that the sand surrounding the pressure point of the foot appears, at first, to dry out and then returns to its previous wetness when the foot is raised. The sand in the depression of the footprint, however, becomes wetter than it was before.

These phenomena are explained as follows: Under the pounding of the surf, the sand settles into a condition in which its grains are as closely packed as possible; any subsequent change or deformation of the sand, as when it is walked upon, forces the grains upward and outward into a more open packing, thereby increasing the interstitial space between the grains and expanding the sand's total volume. The pore spaces in wet sand are filled with water. The new, increased pore volume immediately beneath the footprint is filled with additional water sucked in from adjacent areas. That displacement of water accounts for the partial drying of the region around the print. As the dried-out region gradually becomes saturated again by inflow from its surroundings, the entire area around the footprint will contain more water than it did before. That is why the sand in the footprint looks wetter once the foot has been lifted. When the foot is pressed down, the pore volume expands beneath it, producing a partial vacuum. This causes the sand grains to cling more firmly together, and the sand thus becomes firmer. The strengthening of the sand through a reduction of the pressure of the pore fluid is called dilatancy hardening and is the main reason why wet sand is firmer than dry sand.

Solid rock also exhibits dilatancy. When rock is strongly deformed, small cracks open up and grow in it, producing an increase in pore space. If the rock cracks are initially filled with a pore fluid such as water, as they normally are in the shallow parts of the earth's crust, the increase in pore volume will produce the same effects as in beach sand.

The theory advanced to explain the changes in the velocities of the *P* and *S* waves associated with earthquakes is that the stress that builds up before an earthquake ultimately becomes great enough to cause cracks to grow, which, in turn, results in dilatancy. If the dilatancy is extensive enough to cause the rock to partially dry up, there will be less difference between *P* and *S* wave speeds. This happens because the *P* wave velocity depends on the average compressibility of the rock and the pore water in it (the greater the compressibility, the lower the velocity), whereas the *S* velocity depends on the average shearing resistance of the rock and pore water. Water is nearly incompressible compared to air, whereas both have a negligible shearing resistance. Therefore, if the pore material in rock changes from water to air because of dilatancy-induced drying, the *P* wave velocity will drop, but the *S* wave velocity will be unaffected. Why, then, does the *P* wave velocity return to normal just before the earthquake? For the same reason that the sand does not stay dry around a footprint: water flows in from adjacent regions to fill the voids.

Dilatancy before an earthquake is a naturally buffered process. The pore water at some depth in the earth's crust is normally under considerable pressure from the weight of the water above it. Dilatancy must first reduce that pressure to zero before it can begin undersaturating the rock. This reduction in pore pressure causes dilatancy hardening, which inhibits further dilatancy and also strengthens the fault, thus delaying the earthquake. After dilatancy has stopped, the influx of water from adjoining regions brings the pore pressure up to its original value, the *P* wave velocity rises back to normal, and the increase in pore pressure weakens the fault, triggering the earthquake. The dilatancy mechanism can be compared to a pump. First it reduces the fluid pressure in the region where an earthquake is about to occur, then it allows the pressure to be built back up by the influx of fluid from the surrounding rock. The triggering of earthquakes by an increase in fluid pressure is a well-known occurrence; it explains why earthquakes are often caused by the impounding of deep reservoirs. Because of this phenomenon, earthquakes were created in the Denver area in the mid-1960s when fluid wastes were injected into the crust at the Rocky Mountain Arsenal ten miles from the city.

Once these new observations and ideas concerning the relationship between dilatancy and earthquakes were expounded, they spread rapidly along the scientific grapevine. Researchers at the California Institute of Technology began studying the seismic wave velocities recorded in southern California during the period preceding the disastrous San Fernando earthquake of 1971. They came up with conclusive results: a marked drop in the ratio between *P* and *S* wave velocities preceded that shock by three full years. The researchers also verified that the *P* wave velocity changed the most, as predicted by the theory.

Early last year, those of us working on earthquake prediction at Lamont-Doherty asked ourselves a crucial question. If dilatancy is the correct explanation for the anomalies in wave speeds, what other premonitory phenomena does it cause? Dilatancy is not a trivial process; there must be many other measurable symptoms for which it is responsible.

The answers to this question were immediately obvious. Dilatancy, with its attendant volume increase, would cause an uplift of several inches in the ground around the source area of the impending earthquake. And, since dilatancy would be accompanied by an influx of water into the dilatant zone, the electrical resistivity of that region would fall, water being much more conductive than rock. Documentation of both of these phenomena was found in the observations made years back in various earthquake-prone regions of the world.

One of the best-documented precursors, for example, was a two-inch uplift of the ground that occurred five years before an earthquake destroyed the Japanese city of Niigata in 1964. Another precursor, decreases in electrical resistivity of the crust, had been reported for the earthquakes in Garm that were preceded by the wave anomalies. Even an increase in concentration of the radioactive gaseous element radon, which was recorded in a deep well in the city of Tashkent in the USSR for several years preceding the 1966 earthquake there, could be explained by the dilatancy theory. Radon is released by the breakdown of radioactive minerals in rock. Since it has a half-life of only a few days, the radon concentration within a well could have been increased only by an increase in the rate of flow of water past the well. The flow increase, in turn, would have been the consequence of the pressure gradient set up by a nearby dilatant zone.

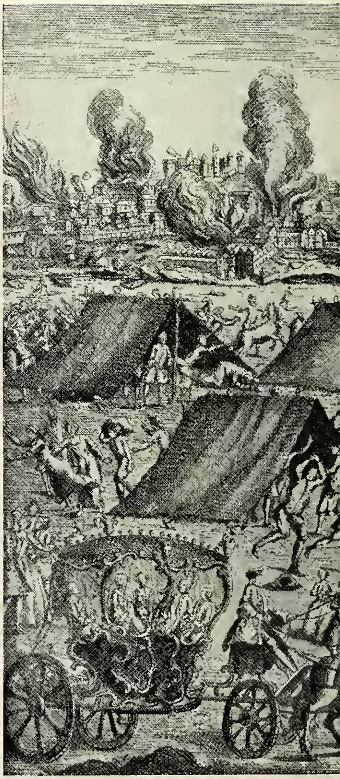
In short, nearly all the premonitory phenomena that had been observed around the world could be explained by the same physical theory. It also appeared that the time duration of individual precursors could be used to predict the size of the earthquake that followed. With the tiniest shocks, such as at Blue Mountain Lake, the precursor lasted only a few days, whereas for larger shocks, as in the San Fernando and Niigata earthquakes, precursors lasted for months or even years. In addition, the time duration of the precursors was found to be proportional to the square of the length of the fault affected by the earthquake. The basis for this ratio is that an earthquake cannot occur until water diffuses into the dilatant zone from adjacent regions, and the time required for diffusion increases with the size of the dilatant zone. Using previous measurements, we have collected at Lamont-Doherty nearly fifty examples of dilatancy-induced phenomena that preceded past earthquakes. Preliminary experiments at prediction have also been made. At Blue Mountain Lake, the earthquake swarm began again in the summer of 1973, and a small earthquake was successfully predicted in advance, based on the change in the ratio of P and S wave velocities.

The dilatancy theory is important because it links all premonitory phenomena to a process that is intimately connected with the cause of earthquakes themselves. Dilatancy results from the same stress buildup that causes earthquakes, but the process of dilatancy hardening delays an impending earthquake until the shock is triggered by the fluid influx that follows the end of hardening. Implicit in the theory, then, are not only the means of predicting the time, place, and magnitude of an earthquake but also the criterion of near infallibility. When dilatancy is observed, an earthquake is sure to follow.

One of the unique qualities inherent in the dilatancy process is the relationship between the duration of precursors and the size of the ensuing earthquake. This scaling not only allows the magnitude of the earthquake to be predicted but it also means that the greater the impending disaster, the longer the warning time. At the onset of dilatancy, the size of the earthquake can be predicted from the size of the dilatant region. In principle, the time duration of the precursor can also be calculated from the size of the affected zone. The most important considerations, however, concern the precision of the possible predictions. It presently appears that the time of occurrence of an earthquake can be predicted to a precision of only about 10 percent of the duration time of the precursor, whereas the location and size of the earthquake can be forecast more reliably.

Earthquake magnitude is expressed by a logarithmic scale that relates size to the energy released. Magnitude 2.0 is about the smallest tremor that can be felt. Most destructive earthquakes are greater than magnitude 6; the most destructive shock known measured 8.9. A magnitude 7 earthquake is thirty times more energetic than one of magnitude 6, and 30 × 30, or 900, times more energetic than a magnitude 5 quake. Applying the dilatancy model to this logarithmic scale, it is found that a magnitude 6 earthquake would have a warning time of about six months, with a margin of error of a few weeks; a magnitude 7 quake would have a warning time of a few years, with a margin of error of a few months. Thus, at present the predicted time of occurrence can only be considered as rough, but there are theoretical reasons for thinking that it can be improved.

Earthquake prediction is currently in the research stage of development. Before the dilatancy theory is completely proved and put into practice, several difficulties have to be surmounted. One fundamental problem remains: We do not know whether all earthquakes are preceded by dilatancy. Those that may not be, obviously, cannot be predicted by this method. The breakthroughs that have already been made, however, clearly indicate that earthquake prediction by means of dilatancy observation



Scores of fires followed the shock wave of the Lisbon earthquake, destroying buildings not already leveled. Much of the populace was forced to take shelter in tents.

will be scientifically and technologically possible within perhaps five years.

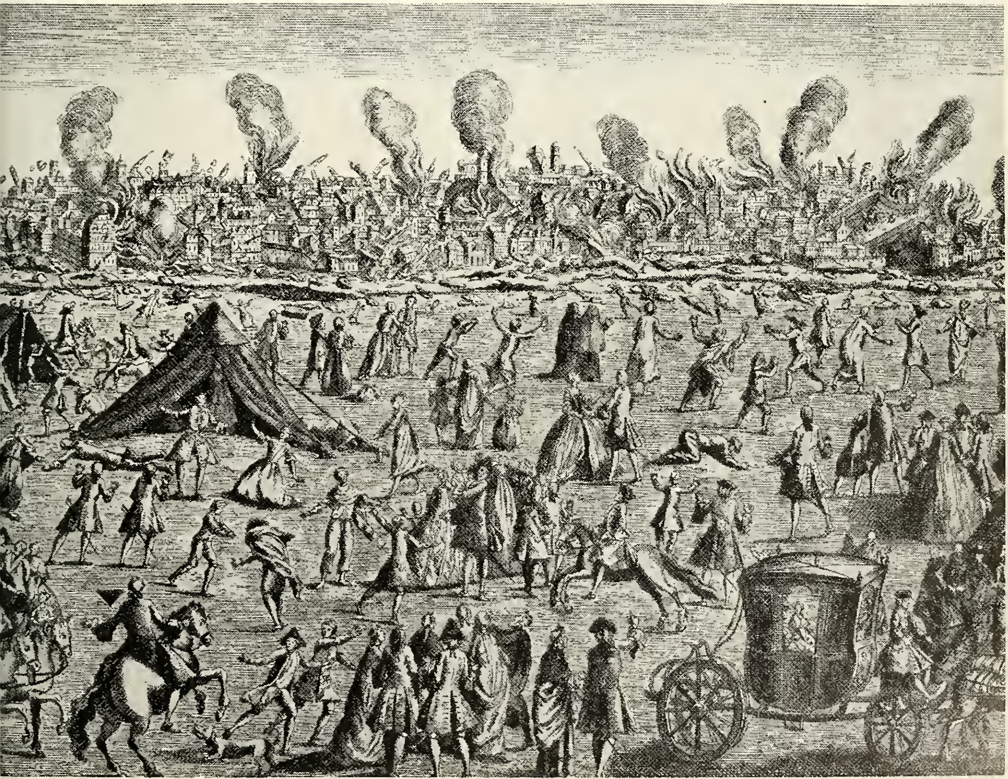
How will advance warning of impending disastrous earthquakes be used? I do not pretend to know the answer, but I do know that it will require clear thinking and good judgment if chaos is to be avoided. Evacuation of the earthquake area would be the most extreme response, to be employed only in rare cases. Other measures could also be taken. Consider, for example, the case of the 1971 San Fernando earthquake. That quake occurred on a supposedly inactive fault that bounds the northeast side of the San Fernando Valley north of Los Angeles. A moderate-sized shock, of magnitude 6.5, it caused half a billion dollars in damage and the loss of 100 lives.

Almost all the destruction came from the collapse of two hospitals, one old and one new, located astride the fault and the collapse of a massive freeway interchange under construction close to the fault. The new hospital had been completed only months before. High as the cost was, an even greater catastrophe was narrowly averted. The area's lower Van Norman Dam caved in to within a foot of the water level in its reservoir. Had that last foot of earth given way, a region populated by 100,000 persons would have been flooded.

According to the CalTech data, this earthquake could have been predicted three years before its occurrence. During that period, construction of the new hospital could have been suspended and the old one evacuated, work on the freeway interchange could have been postponed, and the Van Norman reservoir could have been drained. These actions, together with a general effort to shore up weak structures near the fault, would have reduced damage and fatalities to a small fraction of what they actually were.

But wherever such measures might be contemplated in the future, they would surely have to be taken with extreme caution and should probably be combined with a program of public education designed to eliminate panic. There is also the danger that unscrupulous real estate speculators may cause economic havoc in areas where an earthquake has been predicted. These and many other questions must be thoroughly considered before earthquake predictions can be responsibly made. Nevertheless, the optimist in me argues that the dilatancy theory is a good bet, and some hard thinking should be devoted to learning how to use this new weapon against one of our most feared natural enemies. □

NEW YORK PUBLIC LIBRARY



Life in the Camel's Shadow

The needs of its animals shape a tribe's social organization

Text and photographs by William Torry

The Gabra dwell in a harsh terrain on both sides of the Kenya-Ethiopia border. Along with their neighbors, the Rendille, they are the southernmost of the world's camel-herding tribes, and the two groups may well be the only surviving non-Muslim, camel-raising societies. Approximately two-thirds of the Gabra's 24,000 members live a nomadic life within Kenya's isolated Marsabit district. But the tribe's total territory encompasses a 20,000-square-mile tract bracketed by Lake Rudolf on the west, the Marsabit mountain range to the east, the torrid Chalbi Desert to the south, and the Megado escarpment of Ethiopia to the north. Lava rubble, volcanic ridges, and shallow craters interspersed by gravel patches, salt flats, and palm-fringed sand dunes attest to the region's volcanic origin, and the drabness of the terrain's light cover of acacia trees, bush, and assorted parched grasses adds to its forbidding appearance.

The amount of available water in this land is the factor that most influences how these nomads live. Sweltering plains cover almost three-quarters of the area and receive an annual rainfall of less than eight inches. Annual precipitation in the mountain zones such as Marsabit and the Huri Hills rarely exceeds thirteen inches. Most of the rain falls in sporadic and localized downpours from March to May and from September to November.

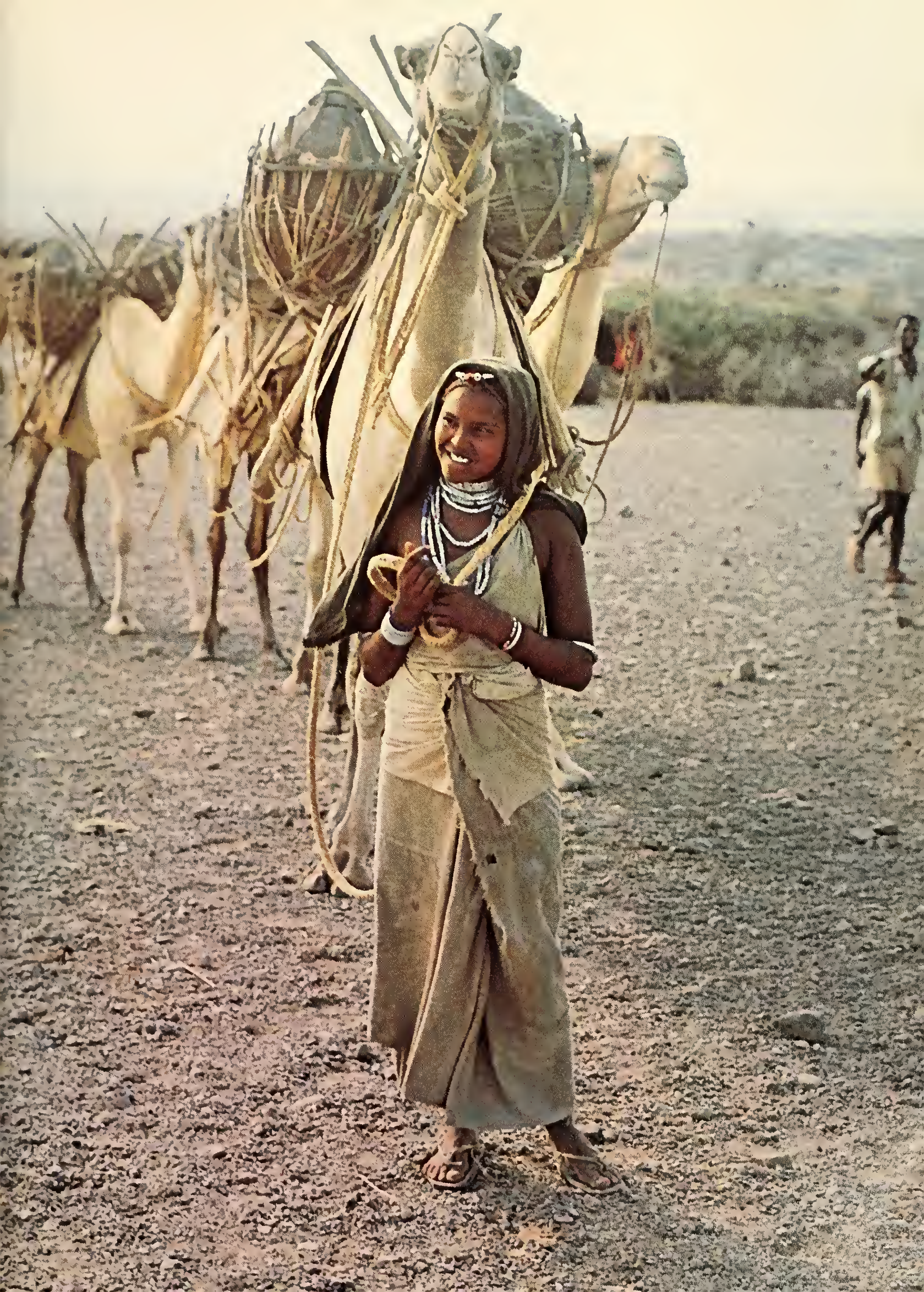
There is sufficient water to meet the needs of humans and animals, but it is not easily come by. The water is confined to a small number of wells, commonly separated from each other by distances of more than twenty miles. Regular movements to Lake Rudolf, the only permanent body of water in the territory, are restricted by its remoteness and proximity to the borders of enemy tribes—Turkana, Dassenitch, and Samburu. Changing forage conditions occasion frequent movements of the Gabra and their herds, usually within an annual circuit of less than 100 miles, and ordinarily, camps shift between the wet season hillsides and the dry season plains. Preparatory to each movement, there is a flurry of activity in the camps with the women dismantling the tents, which they then load, along with domestic goods and small children, on pack camels. The members of each camp usually leave the site together, but shortly thereafter, individuals or smaller groups may relocate with other camps.

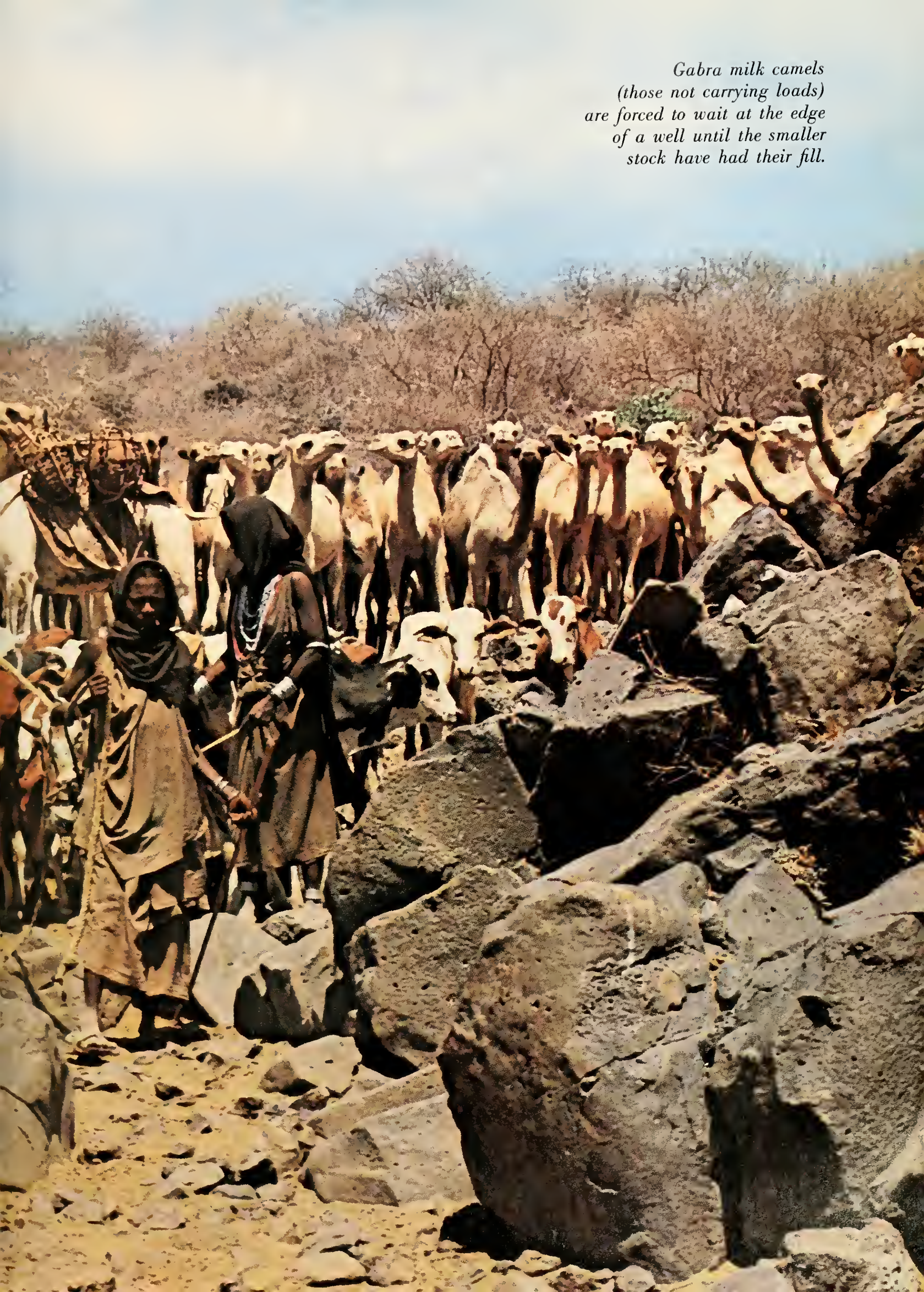
A population the size of the Gabra would not be able to subsist without the use of camels, sheep, and goats. Tilling the soil is considered ritually polluting and conjures up an image in the nomad's mind of the uneventful and unmanly existence associated with sedentary farming. And over-all aridity discourages cultivation. Even cattle husbandry, the most efficient and commonly practiced system of sub-Saharan stock management, could have only limited success here.

The variety of livestock bred by the Gabra reflects the diversity of their background. As far back as the eighteenth century, Somali and Rendille tribesmen emigrated with their camels, sheep, and goats to Kenya's Marsabit district and north into Ethiopia. There they joined Borana and Samburu tribesmen who had emigrated from their traditional lands with their cattle. Over the years, the four ethnic groups intermixed to form the Gabra tribe. Because of the diversity of livestock under their control, the Gabra were able to exploit almost every niche of their habitat.

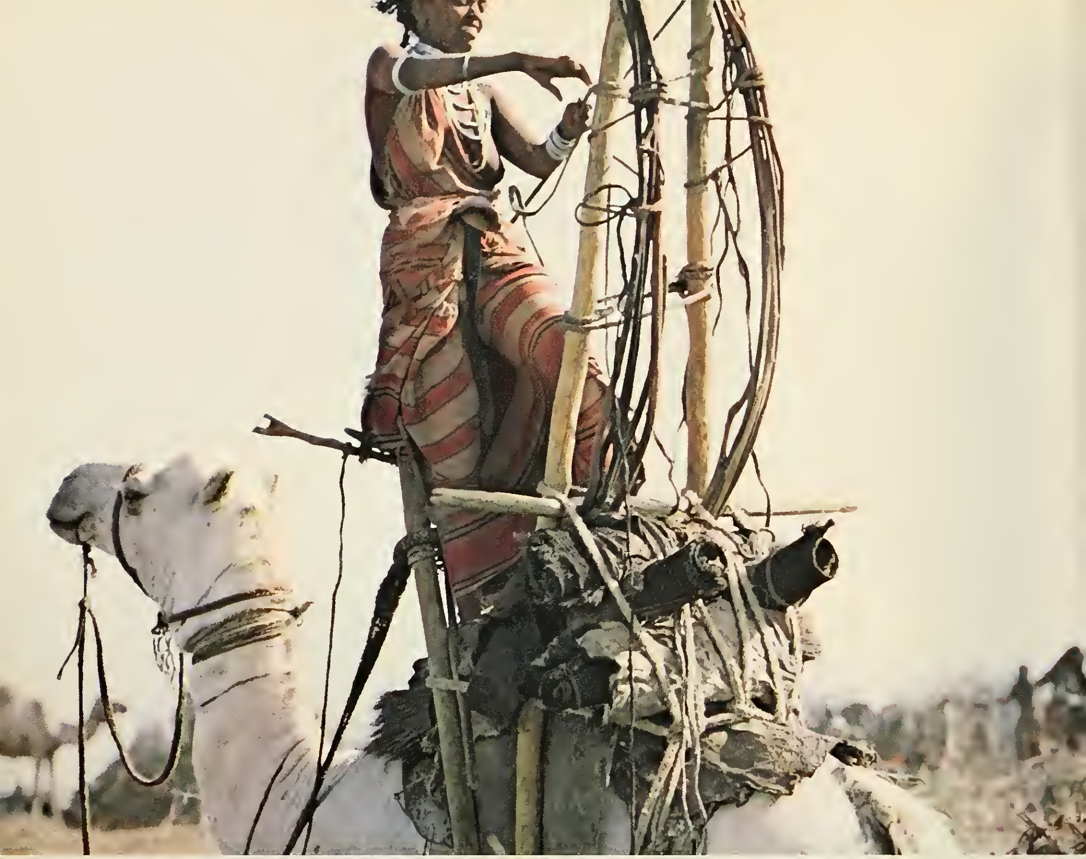
Too cool and tick-infested for camels and small stock, the grassy slopes of the highlands now support herds of cattle. But good cattle country is limited, so that Gabra cannot keep large herds of these animals. The dry season milk yield of cattle scarcely covers one-tenth of a herding unit's daily milk budget. Camels, sheep, and goats prefer the hot, salt-rich plains, which lack the abundant grasses and water required by cattle. Camels form the cornerstone of the native economy and adapt well to their habitat, feeding on small shrubs and grasses and navigating nimbly over the stony land.

One important index of the importance of camels to the Gabra is the animals' association with the main camps throughout the year. These mobile residential units, each averaging more than seventy persons and seventeen tents, are the tribe's ritual and political nuclei. For much of the year the camps are occupied by older married persons and young children. Camp residents are frequently related through multiple ties of kinship and marriage. During the dry season, youths drive the bulk of the sheep, goats, and cattle to satellite camps as far as 200 miles away. Here the animals

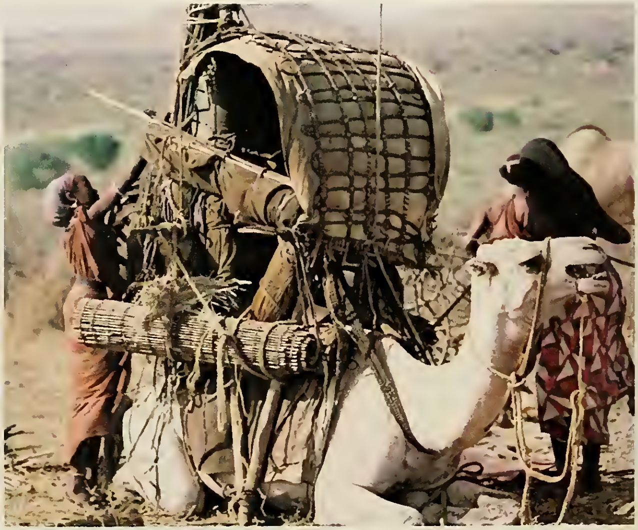




Gabra milk camels (those not carrying loads) are forced to wait at the edge of a well until the smaller stock have had their fill.



When the Gabra move camp, they load their equipment on pack camels. Tent supports, above, and other goods, right, are fastened to a frame on the camel's back, leaving a niche for small children. Each camel carries about 300 pounds.



pasture on lusher forage during the long dry season. Camels, however, are kept close to the main camps because their milk is the mainstay of the dry season diet.

Such dispersion of the tribe can lead to many problems. For example, with youths scattered over

Gabra women are permitted to handle camels only to the extent of loading and leading them. Tribal belief is that a camel herd will become ill and sterile if women milk the females or touch a rutting bull.

the territory at the satellite camps for much of the year, the Gabra can rarely defend themselves successfully in intertribal fighting. Many tribesmen and livestock have been lost during raids by such powerful adversaries as the Somali to the east and the Dassenitch, who live north of Lake Rudolf.

An estimated 40 percent of the camels owned by the Gabra from 1969 to 1971 were adult females. Their total milk yield was sufficient to provide approximately one quart per day for each person in the tribe. A camel in this region seldom produces more than ten quarts of milk daily and then only at the earliest stages of lactation, shortly after the rains begin.

Each Gabra family owns an average of 25 camels, 9 cows, and 125 of such small stock as goats and sheep. Camel holdings of this size are not very impressive by Somali or Bedouin standards, but they do include enough animals to furnish the Gabra upward of 60 percent of their dry season milk supply—the margin of survival during frequent droughts.

The Gabra also subsist through a small amount of trade. Some prosperous merchants have now opened small stores in the few outpost towns of the Gabra territory. Most traders, however, trek through the country with their wares packed on camels. Through trade, the Gabra can purchase maize meal, tea, coffee beans, and sugar. Although selling camels and their products to outsiders is considered sacrilegious, droughts within the past five years have forced tribesmen to this practice. Camel meat and blood are also important in the Gabra diet. Most of their meat comes from livestock, and about 80 percent of this is camel meat. The meat from one large male is enough to supply an entire camp for two to three days. The young men who live at the distant camel and cattle camps rely for nourishment almost entirely on a mixture of blood and milk.

The camel is important to the Gabra not only as a source of food but also for its brute strength. By exploiting the beast's ability to travel long distances burdened with heavy loads, vast stretches of otherwise uninhabitable dry plains lands can be crossed.

During the dry season, the few available water sources—wells, dams, and streams—are heavily taxed. As a result of the scarcity of water, animals overgraze the areas surrounding water sources to a radius of some nine miles, thus forcing the settlements to be located at least this distance from such sites. The Gabra avoid making daily trips to the wells by using their camels to haul large containers of water back to the camp. Each container, woven from wild asparagus roots, can hold five or six gallons of water, and two containers can provide a three- to five-day supply of water for an average family.

Camels are also used to carry the Gabra's leather and mat tents. This gives a family unit the mobility required to respond to suddenly changing pasture conditions.

Without exploiting the milk, meat, blood, and strength of the camel, the nomads would not be able to sustain themselves in the harsh environment of the desert. But camel husbandry has many

If a camel has not been watered for several weeks, it may spend several hours at a water source, alternately drinking and resting until it is satiated.

drawbacks. For instance, there are breeding problems. Compared to other livestock, camels mature slowly and are not capable of conceiving before their fifth to eighth year. They can continue to bear into their mid-twenties, but few survive beyond twenty. A long gestation period—twelve months—irregular mating patterns, and up to twelve months of lactation stretch birth intervals to from twelve to forty months. Even healthy females seldom bear more than eight offspring during their lifetimes.

Actual mating patterns add to the herder's economic woes. When the rains fail, as they often do for several months, the bulls will not rut, so the birthrate is low.

The eating habits of camels pose another set of management problems. The animals do not feed well in pastures containing high concentrations of their dung. Except in lush ranges, camels avoid the area pastured during the preceding days and instead seek patches unspoiled by their droppings.

To determine if a shift of camp is more a consequence of forage depletion than of high dung concentrations is not always easy. Even where forage on unspoiled tracts abounds, camels, unlike cattle, do not remain at one spot long enough to exhaust it. They prefer moving about, sampling scattered shrubs and grasses. Perhaps this exploratory zeal accounts for a herd's highly scattered grazing formations. Cattle often form compact grazing groups, but camels tend to fan out into clusters easily covering one-third of a square mile of open country. This habit makes them easy prey for lions and hyenas and makes a camel herder's work far more difficult than that of a cattle herder. The largest manageable camel herds rarely exceed seventy beasts, and in dense thicket, herds comprise fewer than forty individuals. In contrast, in areas with a thicker grass cover, cattle herds of more than 100 animals are usual.

Other camel habits force their keepers to work hard. Whereas a nomadic cattle-herding settlement may be stationary for several months at a time, the Gabra must move an average of once each month because of a number of ecological factors. The most important is the tick *Rhipicephalus pulchellus,* which carries a disease lethal to camels. As the dung levels in the corrals build up, the ticks infest the excreta. They cannot be eliminated by sweeping out the corrals, since they live part of their life cycle beneath the soil. When dung concentrations reach a certain point the family must move its tent and build a corral on a fresh spot, often no more than three or four hundred yards away.

Although these monthly moves appear minor, the whole camp undergoes the same arduous preparations involved in long-distance migrations. Hence, even though surrounding pastures are only partially grazed, the camp might find it as expedient to move to an ungrazed range three or four miles away as to relocate a mere three or four hundred yards. The tick factor is thus responsible for longer moves, which increase work loads.

Camel anatomy also forces the Gabra to pick up and move frequently during the rainy seasons. A camel's flat, padded feet have little traction on a slippery surface such as a wet corral. The camels must therefore be relocated in areas with more porous soil. Muddy enclosures can so disturb the animals that they try to break out unless promptly moved. Also during the wet season, the camps must move because eating water-soaked plants gives camels diarrhea and drinking surface water bloats them.

The behavioral dispositions as well as the physical needs of camels pose serious management problems for the herder. The Gabra often dramatize the vile, unpredictable temper of the camel when zoomorphizing human traits. Whereas stupid, lazy men are equated with cattle and the irrational person is compared to a goat, the solitary or cantankerous person is associated with the camel. Because it is less habituated to captivity than other livestock, the camel's relationship with man is strained; for the herder this means more work and, occasionally, bodily harm.

Herding is made difficult by the camel's reluctance to return unaided to the camps in the evenings, together with a proclivity for concealing newly born young in the bush. After going without water for several days during the dry season, the beasts occasionally escape the herder's vigil and break away to distant wells. This is one reason why strong young men or elders join the herdboys at sunset to drive the stock home. During the height of the dry seasons or shortly after the rains, herders can often be encountered searching for lost camels. The detective work involved in retrieving stray beasts is both time consuming and irritating. Gabra herders claim that a camel becomes unapproachable after it has been alone in the bush for several days. The herders must often overwhelm such an animal with smoke from a fire built around it. More than half the male camels are gelded so they will be docile enough to carry heavy loads throughout the year. Nonlactating females are also used as beasts of burden, as are bulls on occasion. Pack trains are made up of one line or several lines of camels, each numbering up to eight individuals linked tail and mouth by lead ropes. When traveling with loaded beasts, the herder must stay very close to his charges, supervising their movements and guarding

At a spring in the bottom of a volcanic crater, women use giraffe-skin buckets to fill water containers, which are then loaded on the camels.

against the constant possibility that one or two will step out of tandem, break away, and cause the others to disperse. Catastrophes of this kind result in lost animals and damaged water containers, hides, and domestic utensils.

I was told that one caravan lost seventeen pack camels because the herder did not closely watch his charges. Reports of these disasters, although normally involving fewer beasts, are a frequent topic of conversation in Gabra camps. Tribes using oxen or donkeys for transport have far fewer difficulties of this kind, but these animals are not adapted to the Gabra's environment.

Although camels can inflict nasty bites, they do not normally attack people. Herders are quick to show off a scar or two sustained from a sharp incisor or hoof. Bulls become very unruly during the rut, or musth. An early twentieth-century British veterinarian named Legge has vividly described this behavior as follows:

> The animal is constantly grinding his teeth and often froths at the mouth. He is seen to swallow air like a windsucking horse, and . . . he belches it all out again in what seems to be an involuntary effort, in which the head is drawn back and the eyeballs squint downwards. . . . In addition . . . the animal shows a marked pugnacity to strange male camels, or to those which are also musth, and severe, sometimes fatal injuries are often inflicted in the fight which ensues. . . . Musth camels are often affected with diarrhea, and are certainly unpleasant animals to deal with. . . . A camel's bite is severe; he can tear out a muscle or take the top of one's head off with ease.

Milking and mating routines place additional demands on the herder's attention and energy. Cattle are easily milked by one person, but camels are far less cooperative. The animal must first be hobbled and then milked by two boys. At least one other person must stand by with a stick to prevent the more temperamental cows from biting anyone.

The herder also plays a role when camels mate. Experienced bulls can copulate successfully without human assistance, but coitus occurs more quickly if handlers are present to insure that penetration takes place. Whenever I have witnessed this act, a herder has been on hand to couple the animals. Several other persons are pressed into service to keep curious female camels away from the excited couple.

Another important characteristic of camels is their ability to abstain from drinking for long periods. After a series of downpours, a camel can acquire most of the water it needs from moist forage, but during the dry seasons, the animals must be watered every few weeks, and their appetites decline to the point where they show little inclination to feed except in the cool morning hours or later in the afternoon. Cattle must drink every second to third day, and small stock, every third to fifth day. This does not mean, however, that camel watering is a less arduous operation; quite the contrary.

Camels can consume several gallons of water at one time. Water sources are restricted to a few wells and springs located in the Chalbi desert of Kenya and at Gorai in Ethiopia. Once every ten to fifteen days, strong youths drive the camels an average of twenty miles to be watered.

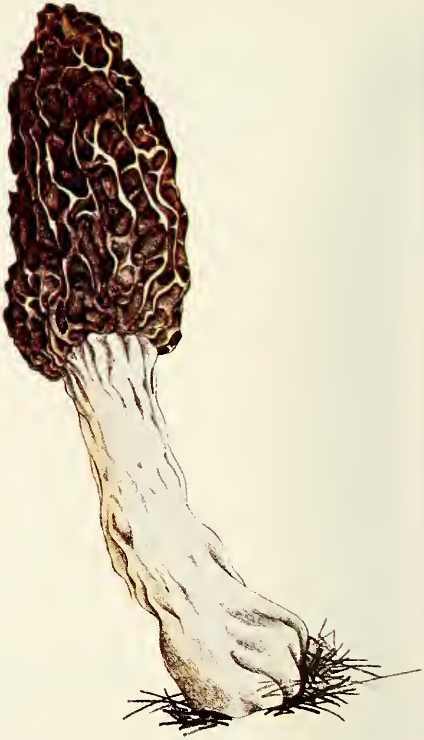
After a one- or two-day walk to the wells through the boulder-strewn hot plains, the herders often encounter long lines of other thirsty herds waiting to be watered. Wells draw all types of stock, and the watering follows an established drinking order. The herders must restrain the camels until the more fragile sheep and goats, and then the cattle, have finished drinking. On very busy days the camels do not get to drink until late afternoon or early evening. But waiting does not mean idleness—far from it. The beasts mill nervously about. If they are not held back, they stampede to the wells, destroying troughs and trampling small stock in the process.

Drawing water from the deeper wells is difficult. A chain of workers stationed at various levels inside the well conveys the water in giraffe-hide buckets to the troughs where at least one person stands ready with a stick to drive back the more aggressive camels. Camels drink their fill in as many as three or four spells, resting between each interval. Each time the animals return, workers must struggle to keep the troughs full of water. Nursing mothers, restless to rejoin their young who have been left behind, look about for an opportunity to make a break for home. The watering process often lasts several hours. Afterward the exhausted herders face a long, hot trek back to the camp.

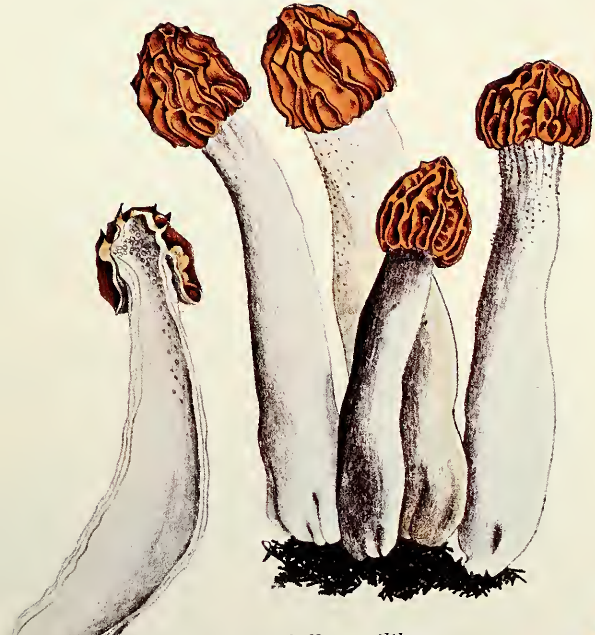
Raising camels permits survival in this arid land, but camel husbandry is no simple matter. Local Gabra groups display three types of fluidity in response to the requirements of their stock. The main camp is mobile, for camel ecology precludes fixed residence. Secondly, members of individual families that make up the main camp are widely dispersed for much of the year. Younger persons spend several months away from home at distant camps with the dry stock thereby relieving local grazing pressures. Thirdly, economic opportunism, born from the variable productivity of the camels, limits the time a family spends at any one camp. Local droughts, stock raids, disease, animal shortages, or any of several other factors prompt the homestead to try its fortunes with neighboring kith and kin.

In the process of meeting these requirements, the human community incurs heavy costs in time and energy. The result is that little social activity occurs independent of the actions of camels. Settlement patterns, the division of labor, and community organization all reflect the demanding nature of camel herding as a subsistence mode. ☐

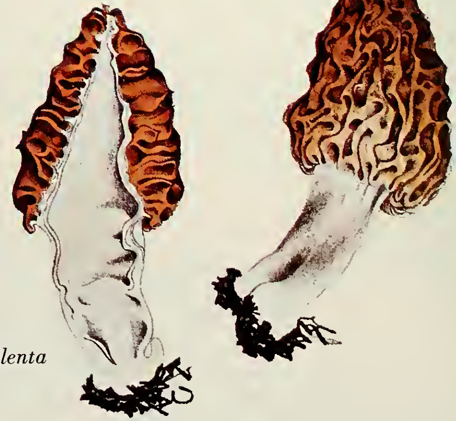
In the arid Gabra territory, cattle must be watered every second to third day; sheep and goats every third to fifth day.



Morchella elata



Morchella semilibera



Morchella esculenta

LOIS LONG

A Morel Tale

The lowly mushroom of man's foraging days now graces the gourmet's table

In a few days now, depending on rain and sun, the morels will be sprouting, raising their long, honeycombed heads under apple and elm trees. Some lucky people have found them in garbage dumps. But they will never tell you exactly where, because they don't want you getting there ahead of them next mid-May when the morels come back.

Morchella esculenta is small but superlative. It is the most delicious of edible mushrooms and among the most difficult to find. In the Middle Ages, whole forests in Central Europe were purposely burned down to provide morels with an ideal breeding ground. Today, its pitted head is cooked in cream (see recipe) and served with pride in the finest of French restaurants. And in Michigan, where it abounds, the morel attracts hordes of hunters armed with capacious baskets and rapacious, gleaming eyes.

Hemingway, when he was up in Michigan (around Harbor Springs in the heart of the Lower Peninsula's morel country), never, so far as we know, lowered his sights from a deer's eye to the even more elusive fungous prey on the forest floor. In this, as in other respects, he was typical of his times. He went after red meat. His atavism only went back so far, and no further, into the dawn of human food gathering. Perhaps, he was only being cautious, for the crash of a stag against brush is loud enough to warn a man, but mushrooms silently kill the unwary.

Amanita phalloides, common, white, and insidious does not produce symptoms for several hours after it has been consumed and fatally absorbed. Violent pains in the belly, wild bouts of vomiting, thirst, coma, and death ensue.

On the other hand, amanitas and other toxic fungi are easy to avoid. Any good, modern, illustrated mushroom guide (*see page 94*) will lead the beginner away from them and straight toward foolproof and toothsome prizes such as the puffballs (white, spherical, smooth fleshed, and sometimes as big as basketballs) or the bright yellow chicken mushroom, a tree-borne fungus rendered unmistakable by its unique sulfur tinge. For the more experienced mushroom-hunter, dozens of other species—boletes and chanterelles—also lurk in the woods a few days after a rain, distended with gastronomic promise.

For the reflective ethnomycologist, the edible mushrooms are more than an exotic foodstuff. They are a link to the earliest stage of human life, when people foraged for their food and ate it raw. Mushrooms are the epitome of this preculinary, precultural phase.

As a result, mushrooms barely figure in the myths of primitive peoples. Even for them, mushrooms are primeval, a food abandoned after the discovery of culinary fire and stone weapons. The Tucuna of the Amazon, for example, refer to mushrooms in a story about a demented hunter of birds who dies in his hammock in delirium. His body, then, is covered with mold and mushrooms, emblems of the wet forest, of rotting food that must be eaten by people who neither hunt nor sow.

Among the English-speaking peoples, mushrooms also take a beating. Spenser wrote: "The grieslie Todestoole growne there mought I se/And loathed Paddocks [toads] lording on the same." And Hugh Walpole: "Queen Elizabeth, when shriveled like a morel, listened with complacency to encomiums on her beauty." Finally, in this century, the most baleful of all mushroom metaphors sprang up twenty-nine years ago: "At first it was a giant column that soon took the shape of a supramundane mushroom" (William L. Laurence describing the Alamogordo bomb test in the *New York Times*, September 26, 1945).

Supernatural mushrooms date much further back. The connection between mushrooms and magic is easy to understand, for mushrooms do not grow from seeds or any other easily visible source, and they spring up overnight. Shakespeare in *The Tempest* echoed the folk view that fairies were behind these mysterious growths: "You whose pastime/Is to make midnight mushrooms that rejoice to hear the solemn curfew." Alice ate a magic mushroom in Wonderland and grew, well, like a mushroom, suddenly.

Magic mushrooms are not just folklore, as serious ethnobotanical research in recent years has shown. R. G. Wasson confirmed earlier reports that the "divine" mushroom of Kamchatka and Mexico, a *Psilocybe*, induces psychedelic trances. He observed hallucinatory Mexican mushroom rituals that closely resembled those described by Bernardino de Sahagún four centuries before: "Some saw themselves dying in a vision and wept; others saw themselves being eaten by a wild beast. . . ."

In the early 1960s the same mushrooms traveled north of the border where they were used widely enough in the youth culture to prompt The Jefferson Airplane, a San Francisco rock group, to record

---

***Raymond Sokolov is a food columnist and editor of* Great Recipes from The New York Times.**

THE WORLD OF LINDBLAD TRAVEL

Lars-Eric Lindblad says: *"There's no better way to see East Africa than on a Wing Safari®"*

You will enjoy our VIP treatment aboard the newly inaugurated "Trislanders." These comfortable, spacious aircraft feature oversized windows that afford unhindered views of the vast migrating herds and exciting game life below. You will visit places where no other Safaris go and travel through thick bush country in sturdy Land Rovers. These Safaris take 23 days and are limited to 10 people.

For those who may be limited by time, we have the ever-popular 15 day Value Safari done completely by land travel. Enjoy luxurious air transportation to and from these Lindblad Safaris aboard the world famous **BOAC-British Airways.** We suggest you write for our new and informative brochure.

LINDBLAD TRAVEL, INC.
Dept. NHS574 (212) 751-2300
133 East 55th Street, New York, N.Y. 10022

NOW there are 8 PETERSON FIELD GUIDES in paperback

JUST PUBLISHED
FIELD GUIDE TO PACIFIC COAST SHELLS
$3.95
FIELD GUIDE TO ROCKY MOUNTAIN WILDFLOWERS
$3.95
FIELD GUIDE TO THE INSECTS
$3.95
FIELD GUIDE TO WILDFLOWERS
$4.95
TO JOIN THESE BEST SELLERS
FIELD GUIDE TO THE BIRDS
$3.95
FIELD GUIDE TO TREES AND SHRUBS
$3.95
FIELD GUIDE TO SHELLS
$4.95
FIELD GUIDE TO WESTERN BIRDS
$4.95

For forty years **PETERSON FIELD GUIDES** have been the criterion by which all other nature guides are judged. For rough use out of doors, these paperback editions have proved highly popular as "second" copies by those who own their clothbound counterparts. At all bookstores.

Write for FREE brochure of *all* 20 Peterson Guides
HOUGHTON MIFFLIN COMPANY 2 Park Street, Boston, Mass.02107
Publisher of The American Heritage Dictionary

a song called "White Rabbit," in which a drug-wise Grace Slick reinterprets the episode of Alice and the mushroom, chanting, "Feed your head."

Nevertheless, Americans are generally not very experimental with mushrooms. We eat cultivated agarics (field mushrooms), more than 100,000 tons a year by the latest official estimate, but the far more interesting wild types rarely appear in markets and are not often hunted down. The French do pursue morels (*morilles*), boletes (*cèpes*), and chanterelles (*girolles*) with considerable passion. And, Cartesian in everything, they have found a way (*duxelles*) to reduce the common mushroom to its essential taste by chopping it fine and sautéing out the water until only a platonic paste remains. The Italians—flamboyant, operatic—serve flat mushroom caps as big as a plate. The Chinese, obsessed with food textures, roll floppy, tender "tree ears" on their sensitive tongues.

The world's leading mycophiles, however, are the Slavs. For them, gathering mushrooms is a basic part of life. They have retained, for reasons unplumbed by ethnography, the ancient folk knowledge necessary for identification (and survival) in the forest. Vladimir Nabokov writes of his mother in *Speak, Memory:*

> On overcast afternoons, all alone in the drizzle, my mother, carrying a basket (stained blue on the inside by somebody's whortleberries), would set out on a long collecting tour. Toward dinnertime, she could be seen emerging from the nebulous depths of a park alley, her small figure cloaked and hooded in greenish-brown wool, on which countless droplets of moisture made a kind of mist all around her. As she came nearer from under the dripping trees and caught sight of me, her face would show an odd, cheerless expression, which might have spelled poor luck, but which I knew was the tense, jealously contained beatitude of the successful hunter. Just before reaching me, with an abrupt, drooping movement of the arm and shoulder and a "Pouf!" of magnified exhaustion, she would let her basket sag, in order to stress its weight, its fabulous fullness.

Mushrooms à la Lucien Tendret

1 pound mushrooms
1 tablespoon butter
1 tablespoon flour
5 tablespoons beef or veal stock
1 cup heavy cream
salt
white pepper
1 egg yolk

1. Under a gentle spray of cold water, wash (but do not rub or scrub) the mushrooms. In the case of morels, cut away and discard the bottom end of the stem, and slice lengthwise down the center before washing to make sure you get rid of sand and grit. Discard any infested with insects. With other mushrooms, slice lengthwise into ⅛-inch slices after washing. One pound of sliced mushrooms will yield approximately 5 cups.
2. Melt butter in your largest, heaviest skillet so that it coats the bottom of the pan. Add mushrooms and sauté over high heat. The mushrooms will quickly give up a considerable quantity of water. Continue to sauté until this has all boiled away.
3. Sprinkle the flour over the mushroom slices and stir to distribute the flour. Lower heat and continue stirring fairly frequently to prevent sticking and burning while the flour browns, about 10 minutes.
4. Pour in 1 tablespoon of the stock. Then gradually stir in the cream. Simmer for 20 minutes. This will reduce and thicken the cream to a rich sauce. Near the end of this period, season to taste with salt and white pepper.
5. Meanwhile, whisk the egg yolk together with the remaining stock. When the cream has finished reducing, remove the skillet from the heat and stir in the egg yolk–stock mixture. This will finish the sauce, giving it a richer, darker color, and the action of the hot cream on the egg yolk will thicken it further.

Yield: Four servings

Note: True morels are easy to identify in the field. The only possible confusion with a toxic species might arise in the case of the false morel. The true morel has a pitted head; the false one is convoluted like a brain.

TRAVEL THE WORLD OF LINDBLAD

Journeys into Antiquity

Lars-Eric Lindblad offers three journeys of classic beauty into Egypt's ancient past. You may desire to travel "A Thousand Miles Up The Nile." You may want to explore "The Blue & White Nile," which includes an expedition into Ethiopia. Or you may want to embark on a journey to "Lands Of Antiquity" which, in addition to Egypt, will take you to Greece and some of its historic islands. These three tours feature unique and exciting excursions into unrivaled archeological places. You will marvel at the sight of great temples and relics of true antiquity. **BOAC-British Airways** will fly you there and back in great comfort. Write for our informative brochure.

LINDBLAD TRAVEL, INC.
Dept. NH N 574
133 East 55th Street, New York, N.Y. 10022
(212) 751-2300

imagine the pleasure of owning your own handsome set of ANTIQUE JAPANESE IVORY CARVINGS (NETSUKES)

YOU CAN START YOUR COLLECTION OF THESE AUTHENTIC REPLICAS TODAY.

These beautiful works of art are faithful reproductions, exact in every detail. There are 24 beautiful pieces in all, offered to you in sets of 4 at only $3.95. For a limited time only you can take advantage of our special offer and order a 12 piece set for only $9.95. Order today and receive **FREE** our specially prepared booklet "The History and Legends of Art Miniatures (The Netsuke)."

MAIL ORDERS TO: IMG PRODUCTS, INC.•27 E. 39th STREET•NEW YORK, N.Y. 10016

NH-2

Please rush me _____ set(s) of the special limited offer of the 12 piece Art Miniature set @ $9.95 per set and/or _________ 4 piece sets at $3.95 per set. Total enclosed $____________

name ____________________

address ____________________

city ____________ state ______ zip ______

MAIL ORDERS TO: IMG PRODUCTS, INC.•27 E. 39th STREET•NEW YORK, N.Y.10016

The Quasar Controversy

No entirely satisfactory explanation has been found for the existence of these puzzling objects

A major storm has been raging in the scientific literature over the esoteric subject of techniques for measuring the distances to quasars. The tempest blew up when quasars—fuzzy, starlike objects of high luminosity—were discovered in 1963 and has continued unabated ever since. Feelings run strongly on the matter because, depending on its resolution, the outcome could shake the foundations of astronomy.

What is a quasar? No one knows. Of all the revolutionary discoveries made in astronomy during the last ten years, none is harder to accept than the existence of this peculiar beast. Quasars are both incredibly bright and incredibly tiny; they are far more luminous than the largest galaxies, which contain many billions of stars, yet they are much smaller than a normal galaxy. The brightest quasar, 3C 273, radiates a thousand times more energy to space than our entire galaxy of 200 billion stars, but it occupies less than one trillionth of our galaxy's volume. The combination of colossal energy output and tiny size makes it nearly impossible to fit quasars into the body of scientific knowledge. This circumstance alone would make quasars front-page news in astronomy. But they have additional interest since, being so bright, they can be seen at a greater distance than any other objects in the sky.

HALE OBSERVATORIES

Astronomers wrestling with the quasar problem have developed a number of theories. None of them works very well. The most conventional theory proposes that a quasar, like a galaxy, is a collection of billions of stars, but one in which the stars are compressed into a very small volume. Some support for this view comes from a recent finding that one quasar—BL Lacertae—is surrounded by a halo of many ordinary stars that are less compressed. Buzzing around in the small volume of the central quasar, like bees in a hive, stars often collide. Now and then a collision leads to a supernova explosion—the cataclysmic event that marks the demise of a massive star. At its peak, each supernova explosion radiates an amount of energy equal to the output of an entire galaxy. One or two supernovas per hour could account for the prodigious energy output from the typical quasar. The theory does not try to explain why such an enormous multitude of stars would be packed into a tiny volume, in defiance of the normal laws that govern the birth of stars in galaxies and regulate their spacing.

Following the discovery in 1968 of pulsars—collapsed stars—another idea likened the quasar to a mammoth pulsar with the mass of a hundred million suns and a density such that one spoonful weighs a billion tons. This giant-sized pulsar would also generate enough energy to account for the energy radiated by quasars. A related idea represents a quasar as a collection of millions of ordinary-sized pulsars, each like the famous one in the Crab Nebula.

The most bizarre theory suggests that the huge energy output of a quasar comes from the annihilation of matter and antimatter. Ordinary matter makes up most of the material in our universe. Antimatter—composed of the counterparts of ordinary matter—is a rare and exotic substance. When antimatter and matter meet, the two immediately annihilate each other and disappear in a burst of pure energy. The energy so released is hundreds of times greater, pound for pound, than the energy yielded by nuclear reactions in atomic bombs and easily adequate to account for the prodigious energy output from quasars. The question is: where would large amounts of antimatter come from? This theory proposes that an antimatter universe exists side by side with ours, perhaps in another dimension, and that what we see as quasars are simply holes in the "fabric" of our universe, through which antimatter is pouring from that other universe. This notion illustrates the extremes to which physicists and astronomers have by Robert Jastrow

been driven in their attempts to explain quasars.

Another solution to the quasar dilemma would be to change the present structure of science. Suppose, for example, that quasars derive their energy from a mysterious force not yet discovered on earth. Stars and galaxies obtain their energy from the nuclear force, which is the strongest force known to man; but an even more powerful superforce may exist unknown to us. Perhaps the quasar is the first clue to the presence of this superforce. This revolutionary suggestion would only be considered as a last resort.

Some astronomers have suggested an easier way out, and their proposal is the crux of the controversy. They propose to solve the mystery of quasar energies by attacking the validity of the methods used for measuring the distances to quasars. They point out that the energy output from a quasar cannot be measured directly, but must be calculated from the apparent brightness of the quasar, as viewed from the earth, combined with a measurement of the quasar's distance from earth. An object may appear very faint in the sky, but if it is far away and its faint appearance is corrected for its great distance, it can turn out to be dazzlingly brilliant. This is the case for quasars: they are relatively faint objects, but a measurement of their distances from the earth reveals them to be very far away. Consequently, if these measurements are correct, their true luminosity turns out to be indeed enormous.

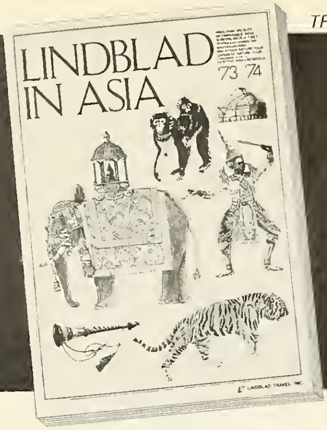
If the distance measurements are wrong and quasars are actually rather close to us, they would not be so brilliant after all, the problem of quasar energies would disappear, and many astronomers would breathe a sigh of relief.

It is a good idea to question the validity of the quasar distance measurements because they rest on very shaky ground. The distance to the sun or moon is relatively easy to measure; even the distances to other stars in our galaxy can be measured fairly accurately, although the closest of these stars is 4⅓ light-years away, and each light-year is about six trillion miles. The closest known quasar is roughly two billion light-years away. Most quasars seem to be even more distant, some of them lying on the boundary of the observable universe. How can such vast distances be measured?

The answer depends on a discovery, made about sixty years ago, that all light from distant galaxies is shifted to the red end of the spectrum, that is, to the longer wavelengths. This red shift is known to occur when the source of the light—in this case a galaxy—moves away from the observer. In cases where the distance to a galaxy can be measured, the amount of the red shift always turns out to be proportional to the distance of the galaxy from earth. This fact suggests that the red shift can be used as a distance indicator in the case of galaxies so remote that their distances cannot be measured by any other means. Red shifts are also used to measure the distances to quasars, since these objects are all very remote.

Several astronomers, however, have found evidence indicating that the red shift of a quasar is not a valid yardstick for its distance. Three years ago, Halton Arp of the Hale Observatories in Pasadena, California, obtained a photograph with a 200-inch telescope that shows a quasar apparently lying very close to an ordinary galaxy. The closeness of the two objects could be merely the fortuitous result of their lying along the same line of sight, but the photograph also shows a bridge of matter between the quasar and the galaxy. The connecting material seems to indicate that the objects are indeed close to one another in space and are, therefore, at about the same distance from us. But the quasar red shift turned out to be twenty times larger than the red shift of the galaxy. The implication is that the red shift of the quasar does not give its true distance, and that this quasar is much closer and, therefore, much less luminous than had been thought.

When the quasar and its "attached" galaxy were photographed again, however, the bridge between them turned out to be explained by a third, presumably unrelated object, lying on the line between the two original objects. Other instances of two seemingly connected objects with widely different red shifts have also disappeared under closer photographic scrutiny.



TRAVEL THE WORLD OF LINDBLAD

ADVENTURE is the word when you travel with Lindblad through *Incomparable India.*

One of Lindblad's great Asian Safaris

Rudyard Kipling comes to life in Lars-Eric Lindblad's exciting new 24-day tour through ancient India. You will see tigers from elephant back in Kahana and you will be guests of the Royal Family of Jaipur at their lodge. Your camera will be constantly at work while visiting spectacular temples and historic shrines. An excursion on the sacred Ganges will reveal strange religious rites as they were performed thousands of years ago. You will see the snow-capped Himalayas to the north. Across the border you will find the remote kingdom of Sikkim with the world-famous Tibetan Lama Monestary. Write for our "Lindblad in Asia" brochure which also includes these tours: **Himalayan Wildlife, Borderlands of Tibet, Persia & Afghanistan, Malaysian Nature Tour, Japanese Nature Tour and Explorers' Tour to Central Asia & Mongolia.**

LINDBLAD TRAVEL, INC.
Dept. NHA 574 (212) 751-2300
133 East 55th Street, New York, N.Y. 10022

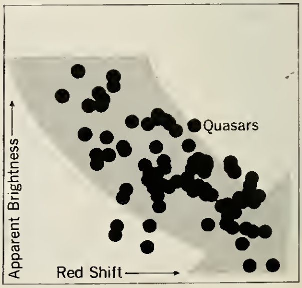
CORNELL LABORATORY
OF ORNITHOLOGY
PRESENTS A
HOME STUDY COURSE
IN BIRD BIOLOGY.

SEMINARS IN ORNITHOLOGY

INQUIRE: LOH, 159 SAPSUCKER WOODS RD., ITHACA, N.Y. 14850

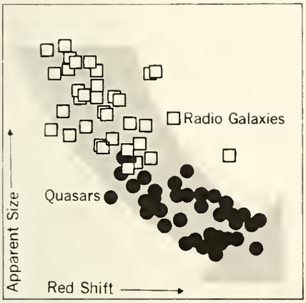
The argument about quasar distances has now flared up again over a tricky question of probabilities. The anti-red-shift faction has searched the records and come up with several cases in which a pair of quasars, or a quasar and a galaxy, are situated very close together and yet have entirely different red shifts. These proponents argue that the probability of this happening by accident is too low to account for the number of cases they have found. Thus, although no direct evidence has turned up for the existence of a bridge between the two objects, this faction concludes that they probably are at about the same distance, and that the case for the use of quasar red shifts as a distance indicator is, accordingly, weakened. On the other hand, the pro-red-shift faction has searched the records and found opposing examples. In one case, the quasar seems to be located in the midst of a cluster of six galaxies, and the quasar and the separate galaxies all have the same red shift.

Each side in this controversy accuses the other of manipulating the probabilities to prove its point. In my view, the most convincing evidence comes from another direction and is of such a nature as to support the validity of quasar red shifts as a distance indicator. The line of argument in this case is straightforward. Suppose a graph is plotted of the apparent brightness of quasars vs. their distance as measured in terms of red shift. If all quasars have roughly the same intrinsic luminosity, then their apparent brightness should decrease more or less uniformly with increasing distance, and the graph of apparent brightness vs. distance should show a clear downward trend. If quasar red shifts are a true indicator of their distance, a graph of quasar brightness vs. red shift should show the



same downward trend. A graph of this kind, adapted from a recent paper by astrophysicist Lodewyk Woltjer, of Columbia University, and Giancarlo Setti, of the Laboratory of Radioastronomy of the University of Bologna, displays an evident downward trend in apparent brightness vs. red shift. The scatter in the points could result partly from errors in the measurements and partly from a scatter in the intrinsic luminosities of quasars.

An analogous argument suggests that a graph of the apparent sizes of the "radio images" of quasars should show a similar downward trend in apparent size vs. red shift, if quasar red shifts are true indicators of their distances. The second graph, adapted from George K. Miley's results, shows apparent size vs. red shift both for quasars and for "ordinary" radio galaxies. This graph is significant for two reasons. First, the quasar points again show a downward trend; second, the quasar trend seems to be a natural extension of the trend exhibited by radio galaxies for which the relationship between red shift and distance is widely accepted.



The battle is not over, although the current consensus favors the pro-red-shift faction. If this faction wins the day, the combination of enormous quasar energies and tiny size will remain to be explained, possibly by making wrenching adjustments in the structure of science. If the anti-red-shift faction succeeds in breaking down the existing confidence in red shifts as distance indicators, the consequences for astronomy will be equally traumatic.

Robert Jastrow, an astrophysicist, is the founder and director of the Goddard Institute for Space Studies in New York City.

Make movies of another world!

A cinematic trip to the Lilliputian world of tiny things is as easy as flipping a switch. The Macro switch on any Sankyo Macro-Focus Movie Camera.

And what an exciting world it is! Suddenly, you can see and film the smallest, most mysterious flora and fauna. There's literally no limit on how close you can get...right down to 0mm, the front surface of the lens.

You'll find yourself inspired, full of original new movie ideas. March along with an army of ants...explore the translucent beauty of the forest's leaves and petals...make a "what's that?" game of extreme closeups... experience the optical magic in a drop of water...it truly is a whole new world of exciting cinema. To make special effects even easier, a ten-piece titling and trick effects kit comes with every Sankyo Macro-Focus Camera.

Choose from five models: from 2.5 to 10x zoom lens. All have through-the-lens viewing, focusing and automatic exposure control, power zoom...and easy drop-in loading with Super-8 film. Discover the world of close-up movies at your Sankyo dealer.

Sankyo Seiki (America) Inc. 149 Fifth Avenue, New York, N.Y. 10010 / 212-260-0200
West Coast Branch: 13000 S. Athens Way, Los Angeles, Calif. 90061 / 213-321-0320

Order your copy of the 16th edition of the Shell Desk Diary

—handsomely bound, gold stamped—full color photographs—fine engravings and space enough to keep a record of everything you plan to do in 1975. Winner of many major awards the 1975 diary will again emphasize shells as a constantly recurring theme in the culture of mankind.

$2.50 each

order today!

No orders will be accepted after August 1, 1974

I enclose $________ for________ copy (ies) of the 1975 Shell Desk Diary. Mail your order to Shell Oil Company, One Shell Plaza, Houston, Texas 77001, room 1536. The Diary will be mailed to you in November. (1)

Name________________

Street________________

City________ State________ Zip________

Celestial Events

by Thomas D. Nicholson

Sun and Moon In the period mid-May to mid-June, the sun's motion northward in the sky slows appreciably as it approaches the summer solstice. Daylight increases from 14 hours 23 minutes on May 15 to 15 hours 00 minutes on June 15, just one minute short of its greatest annual duration at 40° north latitude. The earliest sunrise of the year occurs on June 15.

June is also the beginning of the eclipse year in 1974, with a partial lunar eclipse early in the month and a total solar eclipse later. Neither one is of interest in North America. Our turn comes in December, when a partial solar eclipse will blanket just about all of our continent.

Moonlight will not be an important element of the night until the last week of May. From then through the first twelve days of June there will be some moonlight before midnight. Phases are: new moon on May 21; first-quarter on May 28; full moon on June 4; last-quarter on June 12.

Stars and Planets Summer stars are beginning to dominate the eastern and southern skies now, as early as 9:00 or 10:00 P.M. The bright spring stars in Leo, Bootes, and Virgo are in the western half of the sky by that time. Scorpius and Sagittarius, both well-known summer constellations, are best seen from our latitudes in the early evenings of late May and June, because they are so far south in our sky that they are setting by 10:00 or 11:00 P.M. in late summer.

Venus and Jupiter are morning stars; Mercury, Mars, and Saturn are evening stars. In the dawn sky, Jupiter, low in the southeast before sunrise, is brightening, rising earlier, and becoming more prominent. Venus, brighter, but lower and rising later, is becoming more difficult to see. Mars and Saturn are low in the west at sundown. Saturn, in Gemini, is brighter, but lower, and sets earlier. It probably can't be seen after the first week of June. Mars is higher and to the left of Saturn; it sets about two hours past sunset. Mercury may be seen best during the last few days of May and the first week of June, low in the west about a half hour to an hour after sunset, near Saturn.

May 16: Jupiter is near the crescent moon in the sky this morning. Look for Venus to the left and lower than the moon.

May 18: The moon has moved past Venus by this morning.

May 23: The early crescent moon is between Mercury (below the moon) and Saturn (above the moon) during twilight this evening.

May 24: The moon is at perigee, nearest earth. It is also between Mars (above) and Saturn (below).

May 29: Mars has been moving to the left toward Pollux, brighter of the twin stars in Gemini. Tonight it is nearest to the star and separates to the east (left).

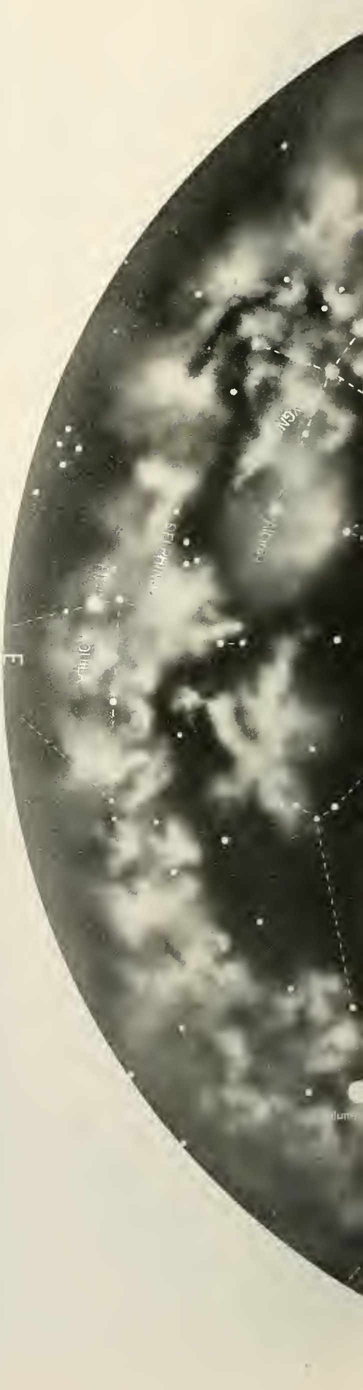
June 1: Mercury and Saturn are in conjunction this evening, low in the west after sundown. Saturn is the lower and brighter planet.

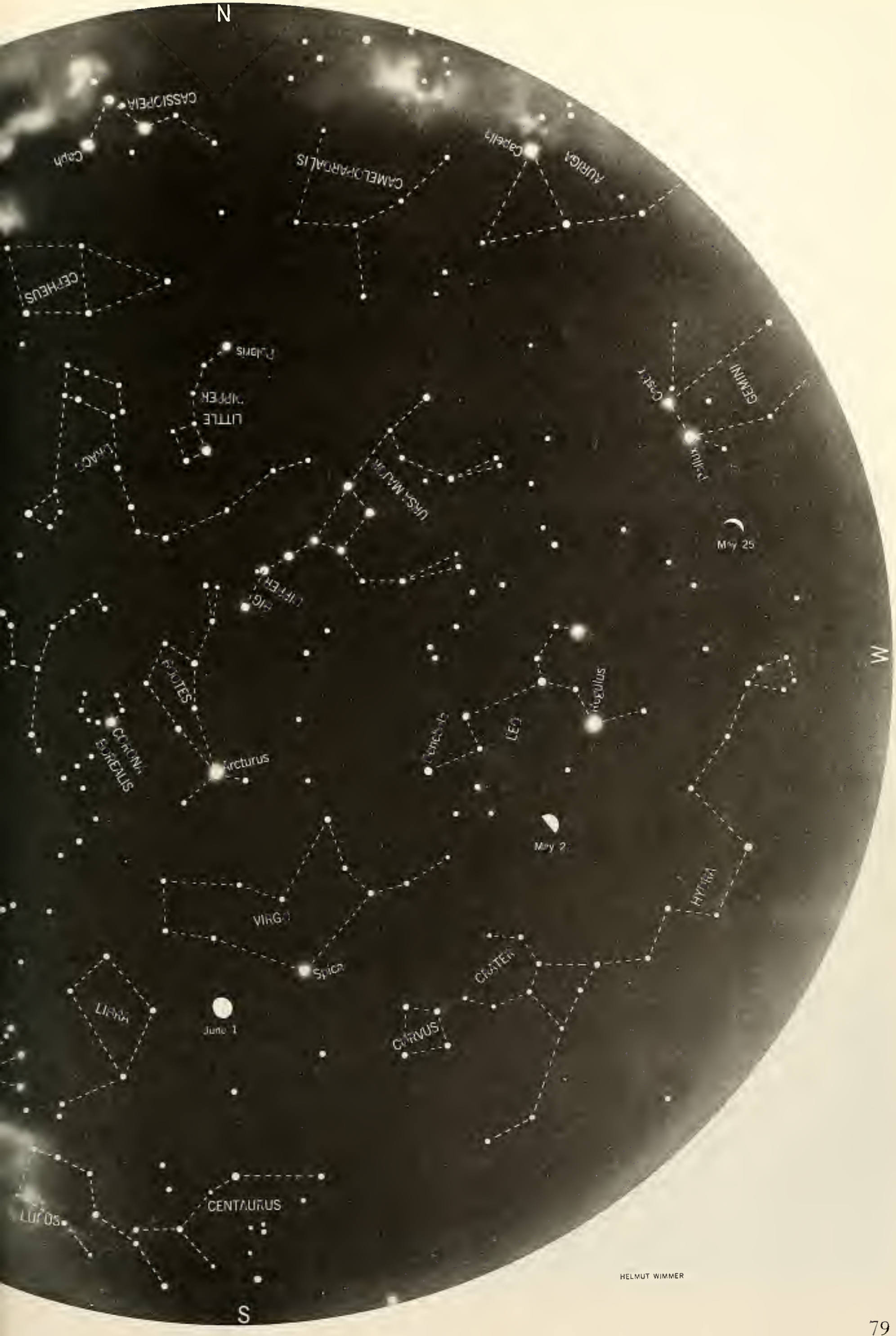
June 4: Mercury is at greatest elongation to the left of the sun in the evening sky. This is a favorable elongation: the planet may be found near Saturn, low in the west after sunset. A partial eclipse of the moon occurs today, but it is not visible in North America.

June 9: The moon is at apogee, farthest from the earth.

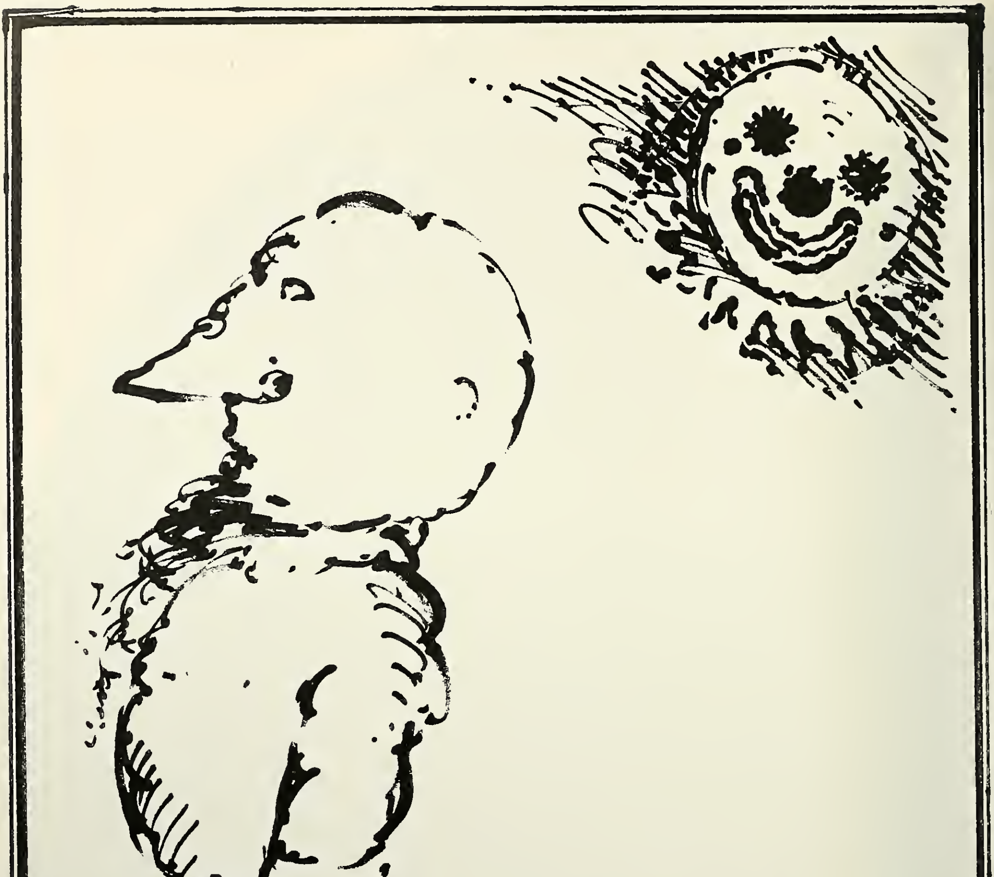
June 12–13: The early crescent moon is near Jupiter on both mornings.

★ Hold the Star Map so the compass direction you face is at the bottom, then match the stars in the lower half of the map with those in the sky near the horizon. The map is for 10:25 P.M. on May 15; 9:20 P.M. on May 31; and 8:20 P.M. on June 15; but it can also be used for about an hour before and after these times.




N
CASSIOPEIA
Caph
CAMELOPARDALIS
Capella
AURIGA
CEPHEUS
Polaris
LITTLE DIPPER
DRACO
URSA MAJOR
BIG DIPPER
GEMINI
Castor
Pollux
May 25
W
BOOTES
CORONA BOREALIS
Arcturus
Regulus
LEO
Denebola
May 2
HYDRA
VIRGO
Spica
CRATER
CORVUS
LIBRA
June 1
CENTAURUS
LUPUS
S

HELMUT WIMMER



KEN RINCIARI

by Brian Sutton-Smith

What Did You Say?

WORD PLAY, by Peter Farb. *Alfred A. Knopf, $8.95; 350 pp.*

Although Peter Farb's book is entitled *Word Play*, it is mainly a work of popular scholarship full of interesting examples of the way in which the people of the world speak to each other. The use of the word *play* in the title seems to be more a piece of propaganda than an accurate statement about the book. It is a book about words but only in small part about play.

It is a remarkable fact of the past thirty years that there has been an increasing interest in the use of play terms. Psychiatrists have written about the "games people play" when they are actually talking about some of the patterns of interaction between intimates. They have not been talking about games as these are usually defined either by the public or by anthropologists. In the early stages of understanding any new field it is natural enough to use metaphors from another field. So the use of the term "game" may have been a good first step, although it becomes an oversimplification if one stops there. Politicians, also, have been known to talk about their "game plans" when they were actually referring to some rather inflexible military policy. Here they were apparently attempting to connote a flexibility to their schemes, which did not in fact exist.

I think that all this means is that we are changing our ideology of play. We are beginning to think about it in new ways. Rather than something to be avoided, it is something to be encouraged. My own theory on this is that current research, which shows that those who play are more creative and those who go into programs where the imagination is developed become more innovative, is encouraging us to believe in play. Also it does happen to be one activity in which children and adults are motivated in what they do. And in a polluted, problematic world, we are beginning to put more trust in human activities that we care about so intensely.

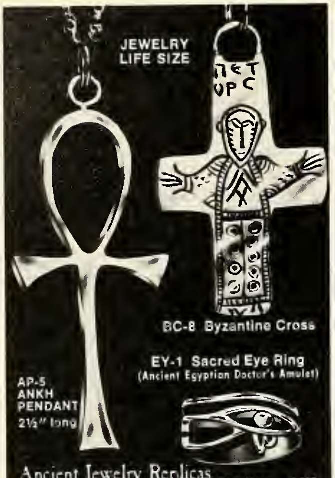
So then, Mr. Farb gains favor for his book by calling it *Word Play*. Let's see how he uses the word "play." First he talks about "the ability of humans to play upon one another with their speech"; then he says, "speakers play with the rules of their speech community," and what makes speech play is that, like a game, it is quite earnest, there are a minimum of two players, it creates audiences, there is something at stake, each player has an individual style, and the outcome is unpredictable. All these factors are certainly characteristics of games, but one must really question whether they do much for the understanding of speech, any more than they do much for the understanding of human relationships in psychiatry. The important point about a game is that it is only unpredictable in a very confined sense. Winning and losing may be at stake on that field at that time, but the rest of the universe is not at stake; and in speech it might be.

In speech, unpredictability can be such a threat that we resort to clichés, stereotypes, and talking about the weather. Speech is often in flight from unpredictability because the possibilities are too stark. Games by contrast welcome their limited unpredictability because it is only an abstract or model of the rest of life, and the players have secured themselves by their rules against life's more ultimate dangers. Play and games are in very important senses the very antithesis of the other types of rule systems that govern speech and society. In play and games the usual power contingencies are reversed. The players are in charge. But elsewhere we are all under the hegemony of man and culture. Think of a game as a micro-rite of reversal, and then speech can be liberated from such a metaphor.

What we are getting in this book is the syllogism about tigers having whiskers and men having whiskers and men therefore being tigers. Even if games have rules and speech has rules, for example, we might add, playfully, speech need not have whiskers. Games mirror society in order to reverse it, or reverse it to mirror it. But either way they don't play it straight, and most of the time speech tries to.

Still, there is a part of speech legitimately called speech play, and there is a chapter in this book called "Playing with Language," which is about the way in which people distort their language, are frivolous, and use disguises, riddles, and puns. This is the one chapter out of sixteen that truly supports the title of the book. But here again we find Mr. Farb smudging the boundaries between play and nonplay. "While linguistic play may stretch the rules, it does not completely break them; even the nonsense of Lewis Carroll's 'Jabberwocky' is not complete nonsense." But what is complete nonsense? The point is that "Jabberwocky" is systematic nonsense. It has a system of rules that are not the conventional rules, and they cannot be the conventional rules even though they mirror them in their own way.

Perhaps it is easier to illustrate with the riddle. There are studies



Ancient Jewelry Replicas
In 14 Karat Gold & Sterling Silver

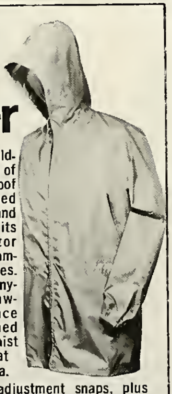
	Sterling Silver	14K. Gold
AP-5 Ankh Pendant 24" ch.	$27.00	$89.00
BC-8 Byzantine Cr. 24" ch.	29.50	95.00
EY-1 Sacred Eye Ring	25.00	89.00

Rings sized to 11½ no extra cost. • Money back guarantee. Add $1.50 for insured postage. • Orders shipped promptly. • Bankamericard & M.C. for orders $50.° minimum.

COLLECTOR'S CATALOG . . . picturing relics from ancient worlds—BC to AD. Plus special Jewelry Catalog showing ancient replicas in precious metals. Both catalogs—50¢. . . . Free With Order!

VISIT GALLERY—APPT. ONLY—CALL CI 6 0793

aladdin house, ltd.
Dept. NJ574 • 648 Ninth Ave. • N.Y. 10036



Give me shelter

All-purpose MPC field-tested hooded parka of windproof - waterproof coated nylon. Coated nylon lining in hood and yoke right down to its drawstring waist tor double protection. Comfortable raglan sleeves. Two-way heavy duty nylon zipper. The drawstring adjusts face opening of attached hood, and hidden waist drawstring adjusts at inside back of parka. Elastic cuffs with adjustment snaps, plus two zippered slash pockets. Wear it over a sweater or Goose Down Vest or by itself in warmer weather. Colors: Sand, Red, Blue, Orange, and Green. Sizes: Men's; S,M,L,XL (Men's S and M will fit Women's Medium and Large). Weight: 12 oz. 0033 NATURALIST Parka $28.50 postpaid.

Please send my NATURALIST Parka.
My check or money order for $__________
is enclosed. (Add sales tax where applicable)
Size__________Color__________
Name__________
Address__________
City__________
State__________Zip__________
Satisfaction Guaranteed or Money Back

Outback
1700 York Avenue, New York, N.Y. 10028

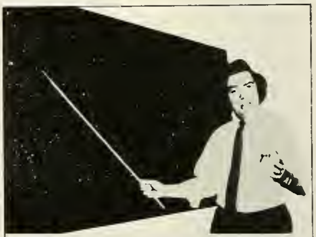
showing that children tend to ask riddles in those cultures in which they are interrogated a good deal by adults. If you are a child, an adult interrogation is both a meaningful event and one that is often impossible to understand. In the riddle, the children expose each other to the same process, but they make the ridiculousness of the occasion more explicit, rather than random and uncontrolled as in normal events. They ask each other, "Why did the dog get out of the sun?" And they answer, "Because he didn't want to be a hot dog." Now this is ridiculous, but at the same time it contains a linguistic law that children are beginning to understand at about the age of seven, which is that homonyms are not necessarily synonyms. So that a dog that is hot from the sun is not necessarily the same dog or the same hot that gets into a bun. What the riddle does is set up an expectancy that certain words presented in the question will mean the same when presented in the answer, which is a normal speech convention. But then gamelike, they reverse the meaning of the provided words, giving them another meaning, which although it was not expected, is also part of the language system. This sort of reversal is thus both nonsense and quite systematic. And so is a game, which puts the players in charge of life (rather than life in charge of the players), and it treats winning and losing as if they are terminable in a fairly clear-cut way in half an hour or so, which they usually are not. So linguistic play does not stretch the rules. It introduces a new sort of rules, and as long as we use play and games metaphorically we will impede the sort of research that tries to ask what sorts of rules are speech rules and what sorts of rules are game rules.

Still, there are at least two other levels in which most of this book is truly playful. The first has to do more with the style of writing than with the definitions provided within it. The book is, as they say, a delight and much fun. It's a quick course in the great variety and diversity of human speech with innumerable diverting examples. Mr. Farb has performed like an entertainer. He has not let the subject get bogged down. All that most of us remember about linguistics are those dreadful years between eight

CANADIAN WILDERNESS TRIPS

[illegible] you to [illegible] and its wildlife in Canada's [illegible] rivers. All inclusive 10 to 13 day [illegible] holidays feature the Coppermine which crosses the Arctic Circle to recreate Sir John Franklin's journey of 1821, the South Nahanni with Deadmen's Valley and [illegible] Virginia Falls, the historic Athabasca and its famous tar sands. For the canoeist, the Wabasca or our beginner's package.

For free brochure write:
NORTH-WEST EXPEDITIONS LIMITED
P.O. Box 1551
Edmonton, Alberta, Canada
T5J 2N7



The *Complete* Star Map With Space Age Accuracy

Our mercalor-type Celestial Map shows you 5,179 stars up to magnitude +6.00. Plus all 88 constellations, Yale Catalog numbers, Greek letters, and 250 star names. For celestial navigators there is a degree scale every 1/10" on the map's perimeter. Stars are sized according to brightness in white on navy; designations are light blue.

Acclaimed by major universities and professional astronomers, our 6½' × 3½' star map will enhance your home or office.

Please send____Celestial Map(s) at $9.95 each (postpaid). California residents add sales tax. Maps sent in crush-proof tubes.

ASTROGRAPHICS, Dept. H., P.O. Box 2411, San Francisco, CA 94126 (415) 282-8333.

and eighteen trying to work out the meaning of subject, predicate, noun clauses, and parsing. To have those dreary memories erased and have that subject matter suddenly become enjoyable is a considerable achievement on the part of the author. Perhaps Mr. Farb has mistaken his own style for the substance and should have called his book *Being Playful about Words.*

Secondly, another contribution to the feeling of playfulness is the great diversity of people and their varied speech customs discussed in the book. For playfulness is not only a reversal of power, it induces a diversity of responses. Succinctly, play might be defined as the envisagement of possibilities. This means that when we are suddenly introduced to a scholarly domain, not systematically, but in terms of a flavoring of very different examples, we get the feeling that this is indeed like play. It is abundant with diversity.

I have devoted most of this review to discussing what is and what is not playful about this book. I might finish by arguing that its very playfulness is not only misleading about play, it is misleading about linguistics. It tends to treat lightly something that is quite fundamental to this book, which is that our lives are largely controlled by our habits of language. This linguistic behaviorism is so much an antithesis to the tone of the book that, in its turn, it creates even further paradoxes.

I could argue for example, that our lives and our futures are as much under the sway of the possible worlds we can envisage in our play and in our arts, as by our language. Children become thinking beings long before they become linguistic ones. Grown persons constantly have intuitions about the way things are or the way things might be *before* they code them in linguistic, mathematical, or artistic terms. We are not entirely the creatures of our language as this book seems to suggest. Play delivers us from words. That is what happens much of the time when people don't talk.

Brian Sutton-Smith is professor of psychology and education at Teachers College, Columbia University, and program coordinator of developmental psychology.

Archaeology

A MAGAZINE DEVOTED TO MAN'S PAST

You don't have to be an expert to enjoy ARCHAEOLOGY, the magazine written for the archaeologically-minded amateur. Reports of excavations and finds, interpretive articles and authoritative book reviews fill each lavishly illustrated issue. This unique quarterly is an official publication of the Archaeological Institute of America.

ARCHAEOLOGY–Dept. NH
260 West Broadway
New York, NY 10013
$8.50—1 year $15—2 years
$22—3 years
☐ I enclose $______. ☐ Bill me
Please send ARCHAEOLOGY to:
Name______
Address______
______Zip______

Not all stereo is hi-fi.
Some people
find out the hard way.

Many of today's bargain stereo systems are styled to resemble real high fidelity equipment. You can unmask them for what they are by listening to the sound. Real high fidelity faithfully reproduces the sound of the original performance. No ifs. No ands. No buts. One way to distinguish real high fidelity is to look for the seal of the Institute of High Fidelity. Your assurance of excellence, it's on products designed by manufacturers dedicated to the ultimate in sound reproduction. There's never a short cut in producing high fidelity equipment. Just in buying it.

IHF

INSTITUTE OF HIGH FIDELITY, INC.
516 Fifth Avenue, New York, N.Y. 10036

VANISHING HERDS. by Harshad C. Patel. *Stein and Day, $15.00; unpaged, illus.*

Although Mr. Patel is a talented photographer, this publication is, unfortunately, just another one of those tabletop picture books of African wildlife designed for gift giving. All the photos are black and white, and there are only twenty-four pages of text. It is a large, thick book—unnecessarily thick because of wasted space: whole pages are blank except for a small picture caption referring to the opposite page; many long, narrow, two-page photos cover only one-third to one-quarter of the spread. Two or three such photos could have been put on a spread, together with captions.

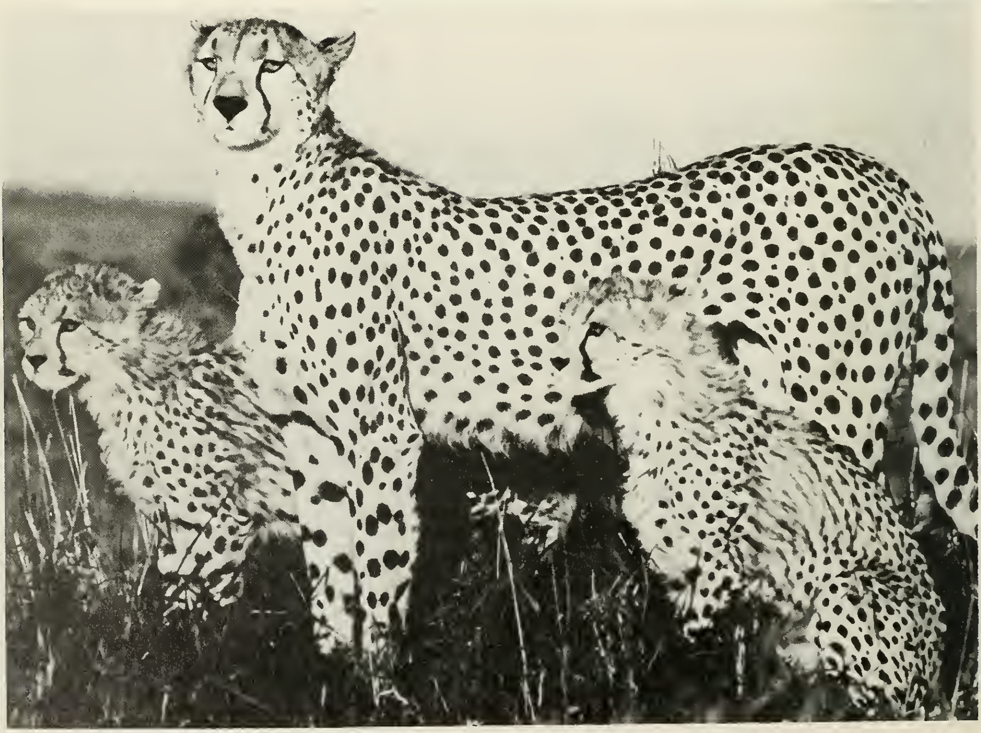
Some sixteen of the photos impressed me as outstandingly beautiful, especially the shots of two reticulated giraffes reclining, of two Masai giraffes in incredibly graceful poses, and a backlighted picture of another reticulated giraffe striding off toward a hazy hill. Giraffes, of course, are highly photogenic, but this does not detract from Patel's artistry. There is a magnificent shot of Ahmed, the giant tusker of Marsabit in Kenya, emerging from a thicket; a shot of crowned cranes landing in procession, like strobelight studies of a single bird's flight pattern; one of a matched pair of seated cheetahs, as well as a formally composed group of three; three lionesses drinking early (or late) in the day; two impala bucks fighting; and three klipspringers on a rock. There are plenty of other good or interesting pictures. But there are too many poorly composed, exposed, or reproduced photos, which it seems the editors hoped to pass off as artistic by making them as large as possible (having perhaps studied old copies of *Life* magazine).

What really condemns this book to mediocrity is not the photographs but the captions and the text, which misinform and mislead in more than a dozen glaring instances. The African elephant is referred to as

"the earth's largest surviving mammal" (true, assuming that whales are fish). "There is reason to believe that they [elephants] have increased in number over the past fifty years, and are still doing so" (only in national parks, as refugees from surrounding unprotected areas). "The powerful legs make it [the cheetah] the swiftest of all land mammals." (If power were the criterion, surely leopards and lions would be faster than the cheetah.) It is further stated that cheetahs begin "gorging their prey as soon as the grasp at the throat extinguishes life." In fact, cheetahs often delay for up to half an hour before starting to feed on their prey.

For me, the climactic nonsense was to find, after reading a caption asserting that cheetah will only kill impala or Thomson's gazelle, a series of three photos on the next pages showing a cheetah grappling a big Grant's gazelle. Incredibly enough, there is not one word of explanation about the most unusual sequence in the book!

I could go on (for example, a caption says that two adolescent



lions walking casually before a group of zebra and wildebeest, which are staring at them from a safe distance, are moving into position just before the kill), but enough said. When compared with a book on the same subject I reviewed earlier in this section—Norman Myers's *The Long African Day*, which not only has beautiful photographs but a wealth of factual information—there would seem to be little reason to buy *Vanishing Herds*, unless you feel it is worth it for the sake of owning Patel's best photographs. And his best ones are very good indeed.

RICHARD D. ESTES
Academy of Natural Sciences
of Philadelphia

HUMBOLDT AND THE COSMOS, by Douglas Botting. *Harper and Row, $15.00; 295 pp., illus.*

In a world that daily grows more specialized and where the most significant accomplishments of science are the

ARCHAEOLOGY TOUR TO MEXICO

JANUARY 19 TO FEBRUARY 9, 1975

Conducted by **THE AMERICAN MUSEUM OF NATURAL HISTORY**

A trip to see the most recent excavations of famous archaeological ruins in Mexico. The past splendor of ancient pyramids and great temples at Tula, Santa Cecilia, Cholula, Tenayuca, Tlaltelolco and Teotihuacan. The hilltop city of Xochicalco, and Teopanzolco near Cuernavaca, and Mitla, Monte Alban and Yagul in the Oaxaca area. Collections in the Anthropology Museum in Mexico City and the treasure from Tomb 7 in the Oaxaca Museum will be studied. Field lecturer is C. Bruce Hunter from the Museum.

Note: The Museum will also conduct a tour to South America in 1975 and an **Archaeology Tour to Maya Mesoamerica in 1976.** Names will now be accepted for waiting lists for these tours.

Clip and mail coupon below:

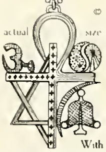
To: Department of Education, The American Museum of Natural History,
79th Street and Central Park West, New York, N.Y. 10024
Please send information for trip checked below to:

Mr.
Mrs.
Miss

Address

City State Zip

MEXICO ☐ SOUTH AMERICA ☐ MAYA ☐



oneness

A subtle linking of
man's religious symbols,
delicately wedded
together by the artisan.
With illustrated descriptive booklet

14K with 24" chain $37.50
Sterling Silver $16.75

ISAAC SOLTES DESIGN NH
1923 S. McPherrin Ave.
Monterey Park, Calif. 91754
Check or Money Order / Money-back Guarantee

Clear days and sparkling nights, in the high mountain valley at the base of Longs Peak, near Rocky Mountain National Park. You'll enjoy horses, hiking mountain climbing breakfast & steak rides; cookouts and cocktails by the heated pool after a packtrip. Golf course nearby. Children's counselor on duty.
Write for brochure.

swiss village
resort & guest ranch

Longs Peak route F
Estes Park, Colorado 80517

NATURE ON STAMPS

The BIRDS & the BEES & the ANIMAL KINGDOM
on GENUINE POSTAGE STAMPS.
* SAMPLES & APPROVALS – $1
Satisfaction Guaranteed

Mil Med Stamps
P.O. BOX 297-NH AURORA, CO. 80010

THE ORIENTAL ART OF BONSAI

BONSAI

IMPORTED FROM JAPAN AND CHINA
FOR HOME, OFFICE OR AS THE PERFECT GIFT IDEA

A LIVING MINIATURE TREE, REFLECTING THE PASSING YEARS IN ITS GNARLED TRUNK AND TWISTED BRANCHES. EACH NEW SEASON BRINGS WITH IT FLOWERS, BERRIES AND CHANGING COLOR. IF YOU CAN WAIT JUST ONE WEEK, WE WILL DELIVER A TREE THAT HAS WAITED ALMOST TWENTY YEARS.

HEIROB BONSAI NURSERY, INC.
Willowemoc Road, Livingston Manor, New York 12758
PHONE ORDERS ACCEPTED (914) 439-5706 NH

Quantity
☐ 12" Japanese Flowering Quince
☐ 8" Blue Moss Cypress
☐ 10" Japanese Cedar
☐ 8" Japanese Elm
☐ 12" Japanese Juniper
....
☐ 1 Tree.......$34.50
☐ 2 Trees......66.00
☐ 3 Trees......97.00
☐ 4 Trees.....125.00
☐ 5 Trees.....150.00
☐ Catalogue

Books on Bonsai
☐ Bonsai, Saikei and Bonkei, $9.00
☐ Introductory Bonsai $7.00
☐ Bonsai for Beginners $6.00
☐ 5 Pce Bonsai Tool Kit, $19.95
☐ 6 Pce Deluxe Bonsai Tool Set in Zippered Pouch, $35.00

Prices include delivery anywhere in North America

Enclosed is my check or M.O. for $__________
including sales tax where applicable.
Bill my__________credit card account
for the full amount plus tax $ __________
☐☐☐ ☐☐☐ ☐☐☐ ☐ ☐☐☐
Exp. Date ________ MC Interbank # ________
Name __________
Address __________
City ________ State ________
Date ________ Zip ________
Signature __________
Phone __________

products of well-equipped laboratories and highly skilled researchers, it is refreshing to acknowledge an earlier period when the understanding of the physical world could be expanded by the scientific odyssey of one perceptive observer of nature. One of the greatest scientific wanderers of the late eighteenth and early nineteenth centuries was Alexander von Humboldt. Stimulated by his travels, he attempted to develop a systematic understanding of the diverse natural phenomena of this world.

Humboldt was a distinctive figure in an age of unique personalities. His name adorns the maps of the world, but perhaps he should be best remembered for the inspiration his career and his writings gave to an assorted pantheon of nineteenth-century scientists—Audubon, Darwin, Louis Agassiz, Gay-Lussac, and William James. Humboldt's interest in astronomy, physical geography, geology, geophysics, biology, botany, ecology, chemistry, physics, mining, electricity, and oceanography testifies to his insatiable curiosity about nature. His devotion to international scientific collaboration encouraged and popularized the idea of joint scientific ventures among nations, and indeed, the international polar projects and the International Geophysical Year are lineal descendants of Humboldt's ideas.

The son of a Prussian courtier who had married a wealthy widow, Humboldt's early years were spent at the family estate near Berlin. Paradoxically, Humboldt, who later demonstrated a genuine talent for quickly assimilating complex scientific observations, was deemed a slow learner by his mother. After eight months of study at Freiberg in 1792, Humboldt obtained a post as a Prussian mine inspector. He accepted his first official position with enthusiasm, and in addition to preparing mine surveys and geological reports, he investigated the dangers confronting miners and developed breathing respirators and safety lamps for their use.

By 1797 the 28-year-old Humboldt had assured himself a brilliant future. By this date he had already distinguished himself

CROWDER NATURE TOURS

. . . resuming after a lapse. The original overseas Nature Tours; started in 1961 several years before the first others joined the field. Still have an amazing world coverage. Do you have our famous "Tour Book"?

Emphasis principally birds, under expert leadership, but non-birders also find our offbeat routes of extraordinary interest. A non-profit operation.

PROGRAM FOR 1974
(No. Am. trips 2 wks.; all others 3 weeks)
[1]Sub-Tropical America: May
[2]Europe: June-July (5 tours)
Africa: East Africa June 29; Madagascar July 20
[3]South Pacific: July-October (7 tours)
Himalayas: Sept. 7 (Nepal-Bhutan-Brahamaputra Valley)
South America: September (Colombia; Venezuela-Guianas)

[1]Sub-Tropical America series now firming up:
Arizona May 25.
[2]Europe: Scottish Islands June 6; Mediterranean June 6; Norway June 29; Middle East June 29, USSR (six weeks, all 15 Soviet Republics, plus Outer Mongolia and around the world) July 20.
[3]South Pacific: Very heavy coverage; if at all interested, do write.

1975 Tours Schedule Now Available on Request.

CROWDER NATURE TOURS
NOTE: Unannounced tours often run; what is your interest?
Box 222-a
Harpers Ferry, W. Va. 25425

Rare Editions for Rare Individuals

If you have a taste for beautiful books and sound investments, you will appreciate membership in The Limited Editions Club.

Only 2000 copies of each Club edition are printed, never more, and they are available *only* to Club members. Leading artists of international reputation are commissioned to illustrate these superb signed editions, each bearing the member's exclusive number.

No effort is spared in the design and craftsmanship of these truly rare — and valuable — editions. And yet the cost is surprisingly moderate.

At the present moment there are a few vacancies in the membership. For a Prospectus, you may write the Membership Secretary at Box 17

THE LIMITED EDITIONS CLUB
Avon, Connecticut 06001
[There is, of course, no obligation]

I want to give Natural History as a Gift

Enter my gift (a one-year Associate Membership in The American Museum of Natural History and 10 issues of Natural History magazine) for the people listed below. **Bill me later at $8 for each gift.**

SEND GIFT TO: ☐ NEW ☐ RENEWAL

NAME

ADDRESS

CITY STATE ZIP

SIGN GIFT CARD FROM:

SEND GIFT TO: ☐ NEW ☐ RENEWAL

NAME

ADDRESS

CITY STATE ZIP

SIGN GIFT CARD FROM:

MY NAME

ADDRESS

CITY STATE ZIP

And That's Not All

With their membership and subscription, my friends will also receive two bonus books (special members' editions); free admission to the Museum; use of the Members' Reception Lounge and a discount in the Museum Shop.

ATURAL HISTORY

Outside U.S.A., please add $2.00 per year for postage.

J122

FIRST CLASS
PERMIT NO. 4946
DES MOINES, IOWA

BUSINESS REPLY MAIL

No Postage Stamp Necessary if Mailed in the United States

POSTAGE WILL BE PAID BY—

NATURAL HISTORY
P. O. Box 5000
Des Moines, Iowa 50306

Want a good looking, thoughtful, lively, and under-ten-dollar year-round gift?

You're holding it in your hand right now.

Part of it, that is. For your gift of a one-year subscription to Natural History includes Associate Membership in The American Museum of Natural History (where admission is free to members) ...as well as two specially selected bonus books a year.

What's more, the price of this many-sided, whole-family gift is well under ten dollars. It's all yours for only $8!

So next time you want to remember a birthday, an anniversary, a graduation or any other special occasion, let Natural History make your good wishes both lavish and long-lasting.

NATURAL HISTORY
published by
The American Museum of Natural History
New York, N Y

*If someone's already made off with the card, just write
NATURAL HISTORY, P O Box 5000, Des Moines, Iowa 50306
Give us your name and address; tell us where the gifts
should be sent (including zip codes, please)
and how you want your gift cards signed.
Send your check with the order ($8 for each gift)...
or if you prefer, just instruct us to bill you later.

WEST AFRICA
AKWAABA
(WELCOME)

2 WEEKS FROM $1130
3 WEEKS FROM $1472
Guaranteed, Escorted, All-Expense Tours

SENEGAL
DAHOMEY
GHANA · TOGO
SIERRA LEONE
IVORY COAST
LIBERIA

Year-Round Departures from New York every other Saturday

Scantravel West Africa AKWAABA

SCANTRAVEL WEST AFRICA
c/o WDI, MUNDY INC. (Suite 1005)
Empire State Bldg., New York City 10001
PHONE (212) 868-0420 · 524 3795

Please send me ______ copies of your free colorful brochure describing the "West Africa Akwaaba (Welcome)" tours.

NH
Name & Title ______________________
Company ______________________
Street ______________________
City ____________ State ______ Zip ____________

CIMOLIOSAURUS

Reptilian bones replaced by beautiful solid opal, over 100 carats, from White Cliffs, Australia. Extremely rare, never before offered for sale. Further details from Barbara Smith, 1 Matters Street, Bilinga, Queensland 4225, Australia.

STRANGE PHENOMENA
A SOURCEBOOK OF UNUSUAL NATURAL PHENOMENA
Compiled by WILLIAM R. CORLISS

Over 350 accounts of ball lightning, the Andes glow, earthquake lights, Indian Ocean wheels of light, the Barisal guns, and other strange geophysical phenomena gleaned from *Science, Nature, Scientific American,* and other publications. Thorough index.

277 pages, hard covers, $6.95 postpaid
Published by
WILLIAM R. CORLISS
BOX 107A, GLEN ARM, MARYLAND 21057

High Hampton
The simple life.

Clear air. Mountains and woods. Birds and wildflowers. An 18-hole par 71 golf course with bent grass greens and seven fast-drying tennis courts. Three lakes for swimming, boating, fishing. Skeet and trap field. Stables. Hiking. Children's program. Inn, country club, and cottages on 2300-acre estate, 3600 feet above sea level in the Blue Ridge Mountains. Comfortable mountain rustic accommodations. Good food. Congenial people.

For more information, write or call:
Miss Agnes Crisp, Reservations Mgr.
High Hampton Inn & Country Club
Cashiers, N.C. 28717. Ph. (704)743-2411 Dept. NH

as a mining inspector, participated in the formulation of the peace of Basel, and published the results of four thousand experiments in "animal electricity." Nevertheless, his restless mind sought other challenges. Influenced by the naturalist and explorer Georg Forster, who had accompanied Cook on his circumnavigation, Humboldt passionately dedicated himself to a life of scientific adventure. Humboldt wished to be, as Forster had been, both a scientist and an explorer. A meeting with King Carlos IV of Spain enabled him to obtain permission for himself and his companion, Aimé Bonpland, to explore Spain's possessions in the New World. Humboldt's South American travels became the cardinal event of his life.

Humboldt arrived in a land that was still awaiting detailed scientific investigation. With Bonpland, he began the arduous task of observing, recording, and describing the flora, fauna, geology, and geography of that continent. In five years he traveled over six thousand miles, collected over sixty thousand plant specimens (sixty-three hundred of which were unknown to European scientists), and filled notebook after notebook with detailed measurements and observations. Passing through the Casiquiare Canal, Humboldt provided proof of the connection between the great South American waterways, the Orinoco and the Rio Negro.

The South American exploits and discoveries were recorded in a monumental thirty-volume study, *Voyage de Humboldt et Bonpland 1799-1804*, which took three decades for Humboldt to complete and whose publication depleted his financial resources. His South American expedition was his primary experience as a scientific explorer, although in 1829 he made a six-month trip across Eurasia to Siberia, a trip that led to the discovery of the first diamond in Russia.

His last years were dedicated to the preparation of his mature reflections upon the physical nature and interrelationships of the world. Begun at the age of seventy-six, Humboldt labored on this work, the *Cosmos*, until his death in 1859. The *Cosmos* is a brilliant attempt to explain the nature, methods, and discoveries of science to an educated public. While it is popular science, it is not "science made easy." It is a work carefully designed to encourage the reader's appreciation of the beauty and complexity of the sustained relationships between the universe and its components.

Lavishly illustrated with selections from contemporary prints, paintings, and engravings, and skillfully composed, Botting's *Humboldt and the Cosmos* presents a sound delineation of Humboldt's career and principal accomplishments. Designed for the general reader, this volume seeks neither to provide a detailed assessment of the methods by which Humboldt reached his ideas nor to evaluate the impact of his thought in the context of scientific development.

PHILLIP DRENNON THOMAS
Wichita State University

THE WORLD'S FINEST MINERALS AND CRYSTALS, by Peter Bancroft. *The Viking Press, $28.50; 176 pp., illus.*

A fleeting magic takes place every time it snows. Hydrogen and oxygen link up according to the strictest laws of molecular attraction and order to become exquisite hexagonal snow crystals. But as countless children have learned, the existence of each tiny flake of perfection is frustratingly transitory. A similarly ordered, far more enduring magic has been achieved throughout the eons of geologic time, and many children who once yearned to hold on to the beauty of the snow crystal have grown into collectors of the vast array of other natural crystals that do not vanish.

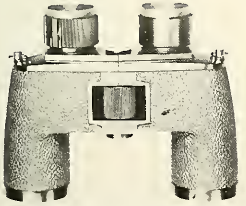
From the depths of the earth to its outermost skin, a limited proportion of the earth's chemical elements arrange and rearrange themselves into solid shapes of seemingly endless variety that are actually describable in terms of only six crystal forms. The variables of formation, the wide variety of changing conditions under which crystallization takes place, assure that optimum conditions for truly perfect crystal development are present in only very limited circumstances. Thus, flawless crystals are

Great Family Fun!

Brown's Original "Hummy-Bird Bar" ® is the perfect choice. Its durability has stood the test of time. Watch hummers sip thru clear plastic cup family style four-at-a-time. (Actual photo) Glass bottle with detachable perch to keep off other birds. No rust, no drip. Beeproof. Guaranteed. Instructions. $3.50 plus 50¢ ea. hndlng & postage. Add 18¢ tax in Calif. No COD's. *Hummingbird Heaven*, 10726-N Samoa Ave., Tujunga, CA 91042. (Makers of the Oriole "Fun Bar") Made in U.S.A.

WRITE ITALIC

Learning the Italic hand is more exciting with the PLATIGNUM ITALIC SET containing a fountain pen, five Italic nibs and our free introductory manual. It allows you to discover which nib widths best suit your developing hand and offers the convenience of having full nib range available for special purpose work. Only $4.50 at artist material, pen and craft shops as well as college bookstores or send check or money order to PENTALIC CORPORATION, 132 W. 22nd STREET, NEW YORK, N.Y. 10011. Add 50 cents to cover handling. State whether right or left handed . . . Nothing is more satisfying than learning to produce the beautiful thicks and thins that characterize the Italic hand and it's easy to do as the pen, held at the proper angle, does most of the work for you. So be a complete penman, own the PLATIGNUM ITALIC SET.

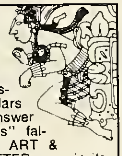


BUSHNELL 7x35 CUSTOM

Mfg. List $139.50 Postpaid $84.50

This is an example of the deep discount prices on high quality optics that is found in our FREE catalog. This catalog lists and illustrates an outstanding selection of camera lens, telephoto lens, telescopes, binoculars etc., plus valuable information on how to properly select them. Write for it today.

GIL HEBARD OPTICS
COURTHOUSE SQ., KNOXVILLE, ILL. 61448



The truth about those "astronaut gods."

At last, a group of prehistorians, egyptologists, astronomers and other scholars have taken the trouble to answer the "Chariots of the Gods" fallacies. Read about it in ART & ARCHAEOLOGY NEWSLETTER, now in its 9th year. Send $6.00 for 8-issue subscription (2 yrs.) to O. N. Reiss Co., 243 East 39th Street, New York, N.Y. 10016.

among the rarer apices of natural creation; of these, relatively few are unearthed by chance exploration or mining and fewer still are snatched from the jaws of crushers or preserved intact from gem-cutting wheels. Also, it seems that like everything else in nature, the supply of crystal specimens is being depleted.

Thus the finest crystals preserved today in museums, universities, and private collections have developed a fame among mineral lovers. Every crystal buff has his own favorites, which he would rank among the world's finest. Dr. Bancroft's book is an ambitious attempt, by a panel of fifty-nine knowledgeable judges and consultants, to picture and describe seventy-eight of the world's outstanding mineral specimens selected from collections the world over. So, while this is, indeed, "still another mineral book," it is one with a new approach—not that of the mineralogist or the gem lover, but that of the collector.

The 1973 index for NATURAL HISTORY may be obtained by writing to: INDEX Natural History, Central Park West at 79th Street, New York, N.Y. 10024

But the book's appeal must surely reach far beyond collectors alone, for who is blind to the beauty of crystals? Some most interesting introductory chapters describe mineral formation and the history of mineral collecting, and a map shows the world's primary crystal mining localities. The Gallery follows—seventy-eight full-page, full-color photographic plates that picture the mineral specimens selected by the judges. The photography and reproduction are superb; the array of crystalline beauty, outstanding. Facing each plate is a brief discussion of the mineral species pictured, a list of collections housing other fine examples of the same species, and some interesting tidbits of information about the origin and history of the specimen portrayed.

The high cost of producing such a volume is reflected in its retail price, which unfortunately must put it out of reach of many. But for those who can afford it, this book will provide a magnificent, at-hand gallery of some of the loveliest structures of natural creation.

BARBARA BLAU CHAMBERLAIN
Geologist—Author

Carry TEN TIMES a Wheelbarrow Load with INCREDIBLE EASE!

These BIG, strong carts are **perfectly** balanced on two huge wheels — roll easily over lawns and gardens — carry up to 400 lbs. of load — huge volume capacity means you make fewer trips — you'll save time **and** steps.

If you are still struggling with a wheelbarrow or inadequate cart (with tiny wheels) send for FREE Cart Catalog.

GARDEN WAY RESEARCH
DEPT. 40355
Charlotte, Vermont 05445

Several sizes—smaller models and Build-it-yourself kits!

The Habitat Guide to Birding

It's just published! The first guide that simplifies bird identification by showing which species you can expect to find in various types of landscape and cover. By Thomas P. McElroy, Jr., author of *The New Handbook of Attracting Birds*. With 100 bird-and-habitat drawings • $8.95 • Knopf

The dignified beauty of an aged tree

BONSAI

Here is a choice collection of aged, authentic originals by Duso, creators of classic oriental art forms in Bonsai. Each tree is an exquisitely shaped, dwarfed specimen born of an ancient art painstakingly cultivated over a thousand years and selected for its hardiness, elegance and charm. These treasured landscapes-in-miniature—planted in imported terra cotta containers—make an original and memorable gift. Free instruction book included. To ensure arrival in perfect condition each tree is nestled in a luxurious shock-proof bed of styrofoam. Prices include all packing and all shipping charges. Allow 2-3 weeks for delivery.

☐	Aged Ficus Benjamina (app. 9" high)	$17.95
☐	Aged Pinus Parviflora (app. 8" high)	21.95
☐	Aged Satsuki Azalea (app. 8" high)	29.95
☐	Aged Japanese Juniper (app. 12" high)	31.50
☐	Aged Japanese Elm (app. 8" high)	35.00
☐	Aged Pinus Pentaphylla (app. 12" high)	49.95

Send name, address, zip code, check or money order (Ill. residents add 5% sales tax) to: Dept. 31

Lifetime® Nursery Products
1866 Sheridan Road, Highland Park, IL 60035
(312) 432-0830

Share the Thrills of Exploring Outer Space!

All DYNASCOPES, including this superb RV-6, 6-inch available on easy terms!

$219.95 f.o.b. Hartford, Conn.

$15 Crating Charge

Now it's easy to join the thousands of serious amateurs who have discovered the excitement of exploring our mysterious universe. Your enjoyment begins right from the start, yet the challenges and rewards go on for years! And it's a hobby that can be shared at modest cost.

Choose From Many DYNASCOPES®

Picking a telescope to fit your needs and your pocketbook is simple when you select a DYNASCOPE—the same instruments used by more than 150 schools, colleges and observatories—and your satisfaction is guaranteed by a full-refund warranty.

FASCINATING GUIDE YOURS FREE!

Read these valuable facts before buying any telescope. Mail coupon or postcard for your complimentary copy of this helpful guide.

Criterion Manufacturing Co.
620 Oakwood Ave., W. Hartford, Conn. 06110

® TM Registered U.S. Pat. Office

CRITERION MANUFACTURING CO., Dept. NH-48
620 Oakwood Ave., W. Hartford, Conn. 06110
Please send your free Telescope Guide.

Name__________

Address__________

City__________ State__________

YOUR SPORT AND FAMILY FUN

You GO CAREFREE anytime with COMPACT Folbot . . . rocky streams, lakes, marsh, surf & open sea GLIDE smoother, faster & NOISELESS with paddles, oars, or sails and ride softly w 1 to 10 HP motors. Many styles & sizes from 1 to 4 seaters. FOLDING or rigid PORTABLE come in PREFAB KIT, or expertly FACTORY BUILT

TRAVEL CRAFT

FOLBOT

NOW from $75 PREFAB KIT or Factory BUILT $139

Folding from $239

NEW BIG DACRON Sail Rig $136

©

FREE ACTION CATALOG

Mail coupon or address to: Folbot Corp. NH-S74
Charleston, S. C. 29405

NAME__________

ADDRESS__________

CITY__________

STATE__________ ZIP CODE__________

Continued from page 9

bility to walk in a forest preserve at night if I want to. I own those forests and beaches and rivers as much as any community or individual with a deed to them.

I seem to be attacking a hallowed Western institution, the right to own property. I like to own things myself, but owning an automobile or camera is really quite different from owning a natural resource. If someone owns a camera, I'm not prevented from buying the same camera. If my favorite beach is owned, no more of that beach can be made. I have lost access to something that belongs to everyone. And if someone decides to cut down the trees in his forest or pave his beach, we are all deprived of something we own. Natural areas are finite, and not everyone can have his own private share of them.

People have to start thinking in terms of custodianship rather than ownership. Communities and private owners have the responsibility of keeping natural areas clean and protecting them from abuse, but not the right to keep nonabusive people away. I understand how the man who has worked hard to buy his own piece of nature will feel, but the present system cannot continue.

I'm really not looking for public ownership of everything—I don't think that works, as government bureaucracy always overpowers the original intent it was created for—but a modification of the idea of natural land, lake, river, ocean, and beach ownership and management is needed. All natural areas should be either (1) public property accessible to all people all the time for all nonabusive purposes, or (2) privately owned with the understanding of custodianship, not control.

Rumblings are in the wind of a gradual nationalization of the American seashore. A section of the Cape Cod shoreline is slated to become a national preserve; people already holding title to property and houses will be allowed to remain but will not be able to keep others off unless they are misusing the land. They also will not be allowed to sell to industry or developers. This is definitely a step in the right direction. No one has the right to curtail my use of any natural area at any time.

MICHAEL FOLEY
Chicago, Illinois

OWLS

Tony Angell

From the tiny elf owl to the fluffy great gray owl, there are eighteen varieties of these beautiful, intelligent birds in North America. Tony Angell has studied them all, in their own haunts or in his home. His delightful book shows them preying, bluffing, decoying, camouflaging—part of the natural community. $12.95

With 63 lovely drawings by the author

University of Washington Press
Seattle 98195

NATURE TOUR TO

ETHIOPIA

BIRDWATCHING
&
NATIONAL PARKS

NOVEMBER 5—NOVEMBER 26, 1974

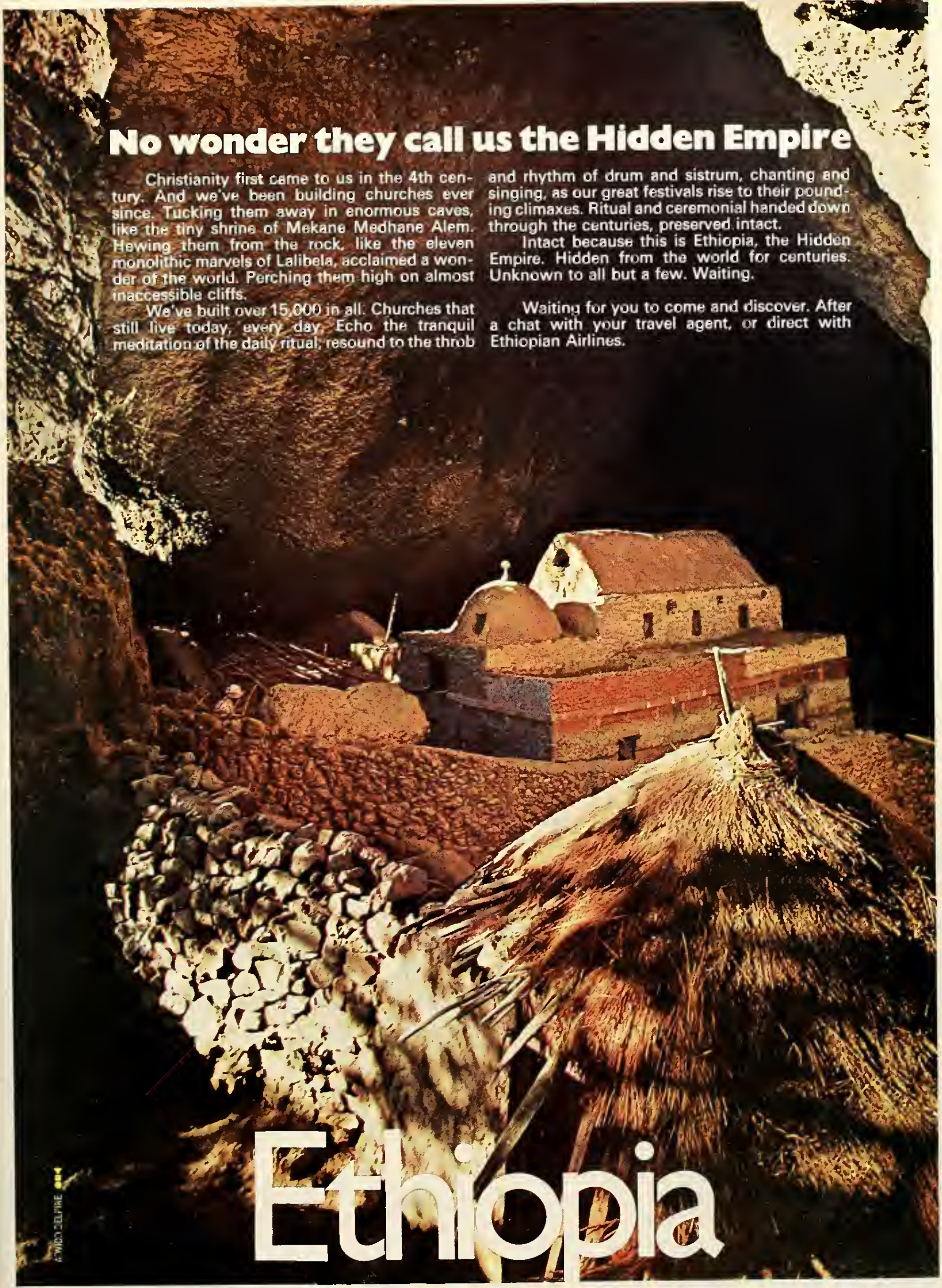
With an Authority on Ethiopian Birds:

JOHN FARRAND, Jr.
Department of Ornithology
American Museum of Natural History

For brochures write to:

OFFICE OF ACADEMIC LIAISON
640 Cathcart Street, Suite 307
Montreal H3B 1M4 — Canada

Brochures also available on our tours to: Australia, New Zealand, New Guinea, Iran, Afghanistan, Pakistan, India, Sikkim, Nepal, Ceylon, Burma.



No wonder they call us the Hidden Empire

Christianity first came to us in the 4th century. And we've been building churches ever since. Tucking them away in enormous caves, like the tiny shrine of Mekane Medhane Alem. Hewing them from the rock, like the eleven monolithic marvels of Lalibela, acclaimed a wonder of the world. Perching them high on almost inaccessible cliffs.

We've built over 15,000 in all. Churches that still live today, every day. Echo the tranquil meditation of the daily ritual, resound to the throb and rhythm of drum and sistrum, chanting and singing, as our great festivals rise to their pounding climaxes. Ritual and ceremonial handed down through the centuries, preserved intact.

Intact because this is Ethiopia, the Hidden Empire. Hidden from the world for centuries. Unknown to all but a few. Waiting.

Waiting for you to come and discover. After a chat with your travel agent, or direct with Ethiopian Airlines.

I'd like to be among the first to discover Ethiopia, the Hidden Empire, with Ethiopian Airlines (daily Boeing flights from Europe). Please send me brochures.
Ethiopian Airlines, 200 East 42nd Street, New York, N.Y. 10017, **Dept. HN-14**
Telephone: (212) 867-0095.

Name ______________________________

Address ____________________________

City ____________ State ________ Zip ________

ETHIOPIAN
AIRLINES
The Key to the Hidden Empire

SECRETS!
GRAHAM HUNTER
?
?

Trapping secrets, that is! Lots of 'em! . . . They're in that fascinating, unusual book—the HAVAHART Trapping Guide. All about animals and things animals do. It tells how to trap 'em *humanely*, too . . . Price list for traps, cages 'n everything is included . . . This great book is FREE and we'd like *you* to get your copy at once. Write for it *today*. Address—

HAVAHART, 158 Water St., Ossining, N.Y. 10562

Please send free trapping guide and price list.

Name____________________________

Address__________________________

City______________State________Zip______

SHELLS MINERALS FOSSILS
INDIAN ARTIFACTS
Send 50¢ for Illustrated Catalog
DOVER SCIENTIFIC
Box 6011 C Long Island City, N.Y. 11106

BOOK HUNTING?

Virtually any book located—no matter how old or long out-of-print. Fiction, nonfiction. All authors, subjects. Name the book—we'll find it! (Title alone is sufficient.) Inquire, please. Write: Dept. 65.

BOOKS-ON-FILE
UNION CITY, NEW JERSEY 07087

Greenhouse gardening is a hobby that will really grow on you!
Write for our catalog.
TURNER GREENHOUSES
Mt. Olive Highway, Goldsboro, N. C. 27530

SUMMER IN THE
WILDERNESS
Climb Adirondack and Big Horn High Peaks.
Canoe voyageur routes in Northern Ontario.
Basic and Advanced Survival Instruction.
Month long Wilderness Expeditions.
Also Weekend/*Custom* Trips: Fall, Winter, Spring
Write for definitive brochure H:
North American Wilderness Survival School
205 Lorraine Avenue, Upper Montclair,
N.J. 07043 Tel: 201-783-7711

Suggested Additional Reading

HARBOR SEAL'S BIRTH (Page 30)

GREY SEAL, COMMON SEAL. R. M. Lockley. October House, Inc., New York, 1966.

SEALS, SEA LIONS, AND WALRUSES. V. B. Scheffer. Stanford Univeristy Press, Stanford, 1958.

THE BIOLOGY OF MARINE MAMMALS. H. T. Andersen, ed. Academic Press, Inc., New York, 1968.

APPLE SEASON (Page 38)

MODERN FRUIT SCIENCE. N. F. Childers. Horticultural Publications, New Brunswick, 1969.

DECIDUOUS ORCHARDS. W. H. Chandler. Lea and Febiger, Philadelphia, 1957.

APPLES AND APPLE PRODUCTS. R. M. Smock and A. M. Neubert. Interscience Publishers, Inc., New York, 1950.

NORTH AMERICAN APPLES. R. F. Carlson, et al., eds. Michigan State University Press, East Lansing, 1971.

A PARASITE'S ODYSSEY (Page 46)

HUMAN SCHISTOSOMIASIS. P. Jordan and G. Webbe. Charles C Thomas, Publisher, Springfield, 1969.

MANSON'S TROPICAL DISEASES. P. Manson-Bahr and C. Wilcocks. The Williams and Wilkins Company, Baltimore, 1972.

QUAKE FORECASTING (Page 54)

ABOUT EARTHQUAKES. G. A. Eiby. Harper and Row, Publishers, New York, 1957.

ELEMENTARY SEISMOLOGY. C. F. Richter. W. H. Freeman and Company, Publishers, San Francisco, 1958.

EARTHQUAKE PREDICTION. Carl Kisslinger. *Physics Today*, March, 1974.

THE CAMEL'S SHADOW (Page 60)

A TREATISE ON THE ONE-HUMPED CAMEL IN HEALTH AND DISEASE. A. S. Leese. Haynes and Son, Stamford, 1927.

THE FAMILY HERDS. P. H. Gulliver. Greenwood Press, Inc., Westport, 1955.

A PASTORAL DEMOCRACY. I. M. Lewis. Oxford University Press, Inc., New York, 1961.

A MOREL TALE (Page 70)

THE MUSHROOM HUNTER'S FIELD GUIDE. A. H. Smith. The University of Michigan Press, Ann Arbor, 1963.

MUSHROOMS OF NORTH AMERICA. O. K. Miller, Jr. E. P. Dutton and Company, Inc., New York, 1972.

SOMA. R. G. Wasson. Harcourt Brace Jovanovich, Inc., New York, 1972.

THE SAVORY WILD MUSHROOM. M. McKenny. University of Washington Press, Seattle, 1971.

WHEN YOU WRITE TO NATURAL HISTORY MAGAZINE

Cut your old address label from magazine wrapper and attach over this area.
Fill in your NEW address below and mail to:
Natural History Magazine
Membership Services Box 6000
Des Moines, Iowa 50306

H001

☐ 1 year—$8 ☐ 2 years—$15 ☐ 3 years—$21
(Add $2 per year to Canada and other non-U.S. orders)

PLEASE PRINT

Name ____________________________

New Address________________________

City ______________State _______Zip _______

about a change of address, renewal of subscription, billing, or any kind of adjustment, send the present address label from the magazine wrapper.

Moving? Please notify 6 weeks in advance.

You can use this form to tell us about a move or order a subscription.

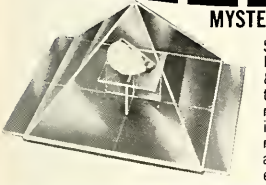
Change of address—attach your address label in the dotted area and fill in your new address at left, clip and mail to: Natural History Magazine. Membership Services, Box 6000, Des Moines, Iowa 50306.

A new subscription—Check box and fill in name and address at left.

LIVE IN THE WORLD OF TOMORROW...TODAY!

A BETTER LIFE STARTS HERE

(And our FREE CATALOG is packed with exciting and unusual ecological & physical science items—plus 4,500 finds for fun, study or profit . . . for every member of the family.)



MYSTERY OF ENERGY AND AGING

Science fact or farce? Can our Great Pyramid unlock the mysteries of energy & aging—show that the ancient Egyptians contradicted nature? Did someone really get 85 shaves from a blade kept in a pyramid? Test claims like meat not rotting, things not rusting! Users of exact scale models of Cheop's pyramid oriented to true North claim all sorts of strange phenomena based on resonating energy. Ours is already assembled, ⅛″ see-thru acrylic, 6x9¼x9¼″.

Stock No. 71,817E ....$20.00 Ppd.

AUTHENTIC SCALED WINDMILLS

Real-thing replicas show wind direction, wheel silently revolves on ball bearings. Give your grounds unique rural charm! Great centerpiece for planter, flowers. Use to hold yard light, house number, sign or as mailbox. For school, a fine "energy crisis" science project—does everything but pump water. Heavy gauge steel, durable outdoor finish; aluminum color w/red trim.

No. 71,923E..(17″ DESK MOD.)..................$10.95 Ppd.
No. 71,924E..(4½′–14 LB)............$32.50 Ppd.
No. 85,229E..(8′–46 LB) $44.95 FOB

"FISH" WITH A MAGNET

Go treasure hunting on the bottom! Fascinating fun & sometimes profitable! Tie a line to our 3½ lb. Magnet—drop it overboard in bay, river, lake or ocean. Troll it along bottom—your "treasured" haul can be outboard motors, anchors, other metal valuables. 3½ lb. Magnet is war surplus—Alnico V Type—Govt. cost twice our price. Lifts over 40 lbs. on land—much greater weights under water.

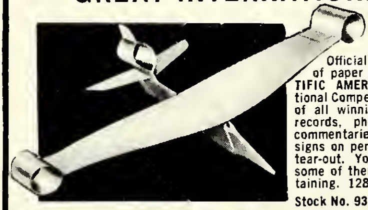
Stock No. 70,570E 3½ lbs...$11.50 Ppd.
Stock No. 60,215E 1½ lbs..$6.50 Ppd.

KNOW YOUR ALPHA FROM THETA!

For greater relaxation, concentration, listen to your Alpha-Theta brainwaves. Ultra-sensitive electrode headband slips on/off in seconds—eliminates need for messy creams, etc. Atch'd to amplifier, filters brainwaves, signals beep for ea. Alpha or Theta wave passed. Monitoring button simulates Alpha sound; audio & visual (L.E.D.) feedback. Reliable, easy-to-use unit—comparable to costlier models. Completely safe. Comprehensive instruction booklet.

No. 1635E. (8x3x4″; 24 oz.)....................................$128.00 Ppd.
LOW COST "STARTER" UNIT
No. 71809E....................................$49.95 Ppd.

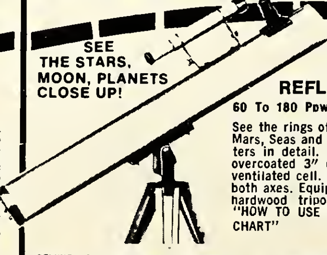
GREAT INTERNATIONAL PAPER PLANE BOOK!



Official fly-them-yourself book of paper airplanes from SCIENTIFIC AMERICAN'S "1st International Competition". Includes plans of all winning entries, time-aloft records, photos, technical data, commentaries. Has 20 unusual designs on perforated pages for easy tear-out. You won't believe how some of them fly! Amusing, entertaining. 128 pages, 9″ x 11¾″.

Stock No. 9391E .... $2.95 Ppd.

"STICK-PAPER AIRPLANES" BOOK Stock No. 9427E .... $4.95 Ppd.



SEE THE STARS, MOON, PLANETS CLOSE UP!

3″ ASTRONOMICAL REFLECTING TELESCOPE

60 To 180 Power. Famous Mt. Palomar Type

See the rings of Saturn, the fascinating planet Mars, Seas and Craters of the Moon, Star Clusters in detail. New improved, aluminized and overcoated 3″ diameter f/10 primary mirror, ventilated cell. Equatorial mount with locks on both axes. Equipped with 60x finder telescope, hardwood tripod. Included FREE: VALUABLE "HOW TO USE YOUR TELESCOPE" book; "STAR CHART"

DELUXE 3″ REFLECTOR TELESCOPE Stock No. 80,162E..............$66.50
4¼″ REFLECTOR TELESCOPE (45x to 270x) Stock No. 85,105E..............$115.00 FOB
4¼″ REFLECTOR TELESCOPE WITH CLOCK DRIVE Stock No. 85,107E..............$149.95 FOB
6″ REFLECTOR TELESCOPE Stock No. 85,187E..............$222.50 FOB
6″ REFLECTOR W/(ELECTRIC) CLOCK DRIVE No. 85,086E..............$259.50 FOB

ORDER TODAY! COMPLETE AND MAIL

EDMUND SCIENTIFIC CO.
300 Edscorp Building, Barrington, N.J. 08007

How Many	Stock No.	Description	Price Each	Total

PLEASE SEND ☐ **GIANT FREE CATALOG "E"**
MERCHANDISE TOTAL $
ADD HANDLING CHARGE: $1.00 ON ORDERS UNDER $5.00; 50¢ ON ORDERS OVER $5.00
TOTAL $

30 DAY MONEY-BACK GUARANTEE
YOU MUST BE SATISFIED OR RETURN ANY PURCHASE IN 30 DAYS FOR FULL REFUND

NAME ____________
ADDRESS ____________
CITY ____________ STATE ____________ ZIP ____________
I enclose ☐ check
☐ money order for $____________

MAIL COUPON FOR GIANT FREE CATALOG!

180 PAGES • MORE THAN 4,500 UNUSUAL BARGAINS

Completely new '74 Catalog. Packed with huge selection of telescopes, microscopes, binoculars, magnets, magnifiers, prisms, photo components, ecology and Unique Lighting items, parts, kits, accesories — many hard-to-get surplus bargains. 100's of charts, illustrations. For hobbyists, experimenters, schools, industry.

EDMUND SCIENTIFIC CO.
300 Edscorp Building, Barrington, N. J. 08007
Please rush Free Giant Catalog "E"

Name____________
Address____________
City____________State____________Zip____________

Announcements

The Department of Education has planned an **Archeological Tour to Mexico** for next January. Flying first to Mexico City, the tour group will continue to such archeological sites as Tlaltelolco, Tenayuca, and Santa Cecilia; explore colonial structures at Tepotzotlán and Puebla and Cuernavaca; and visit the museums in Oaxaca, Teotihuacán, and of course, Mexico City. Because museum field study tours are often fully booked well in advance, anyone interested in the "Archaeology Tour to Mexico" (January 19 through February 9, 1975) should write *now* to C. Bruce Hunter at The American Museum for complete information, including a full itinerary.

The Alexander M. White Natural Science Center opens on May 8. This new feature at the Museum focuses on nature from the view of the city child: nature in the crack in the sidewalk, nature under the concrete and above it. The new Center, which will be reserved for school groups in the morning, will be open to the public from 1:30 to 4:30 P.M. Monday through Friday; noon to 4:30 P.M. on Saturdays; and 1:30 to 4:30 P.M. on Sundays.

On May 7 the new **Sky Show,** "Jupiter Journey," begins at the Hayden Planetarium. The program traces the journey of the space probe Pioneer 10 to Jupiter and describes our solar system on the way. Sky Shows are at 2:00 and 3:30 P.M. during the week, with more frequent showings on weekends. Admission is $1.75 for adults; $.90 for children.

Evolution of the Human Brain Dr. Elliot S. Valenstein of the University of Michigan will speak in the Museum auditorium on Thursday, May 16, at 8:15 P.M. His subject will be the human brain, our knowledge of how it controls behavior, and the limitations of this knowledge. Dr. Valenstein's lecture, part of the James Arthur Series, is open to the public and is free of charge.

The Puerto Rican Dance Theater will perform in the Museum auditorium on Wednesday, May 15 at 8:00 P.M.; on Saturday, May 18 at 3:30 P.M.; and on Sunday, May 19 at 2:00 P.M. Tuesday, May 28, is **Golden Age Day** and senior citizens will be admitted to the Museum free of charge. At 2:00 P.M. Dr. Malcolm Arth will talk about his research. Refreshments will follow.

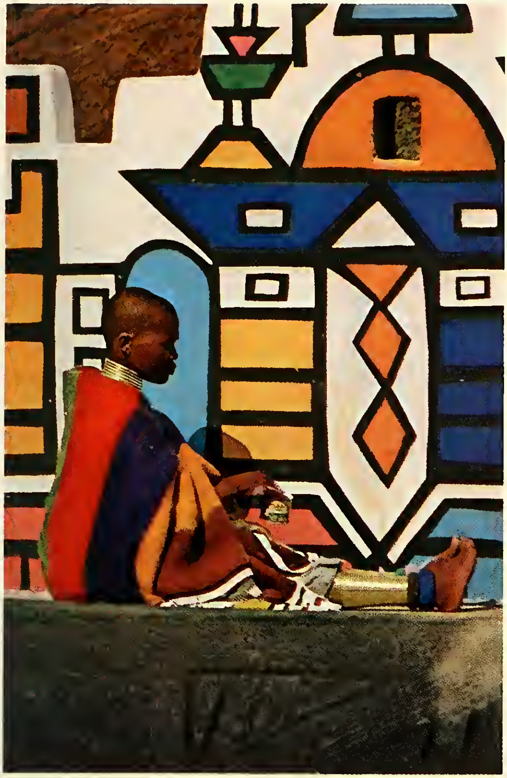
Window to the Sea This new exhibit, opening May 16, recreates some of the on-going projects at the Lerner Marine Laboratory. The Laboratory, one of our Museum field research stations, is on Bimini Island in the Bahamas—a good location from which to study the behavior of subtropical marine animals. The exhibit will feature the underwater television used on the site, as well as a life-scale model of a diver in scuba gear.

The public is invited to a **Caribbean Musical Festival**—with live bands—to take place at 2:00 P.M. on Sunday, May 26, in the Museum auditorium.

Tuesday, May 28, at 2:00 P.M. Juanita Munoz of the Museum will lecture on **"Artists in Ancient South America."** This talk and slide show is the last of the weekly spring lecture series on anthropology. These lectures, open to Museum visitors, are given in the People Center. □

Come to South Africa and...

look at our art,



or look at our art.

The women artists of the N'debele village have created abstract, geometric murals on the walls of their houses with masterly precision. There's something about the broad, bold strokes and bright, rich colors that has been an inspiration to artists like Picasso, Leger and Modigliani.

And the beadwork and blankets these women weave capture the same primitive spirit found in their paintings.

This fascinating village is just a short ride from Pretoria. And, as is the case with most South African art, you won't have to look *for* it to look *at* it. It's part of the scenery.

The work of great sculptors can be seen in public squares throughout South Africa. Ernest Ullmann's "The Playmakers" (illustrated above) stands in front of Johannesburg's Civic Theatre.

SAA has the fastest, most direct route to this land of wonderful contrasts via 707s to Rio de Janeiro. We also fly 747s that connect with 13 major European cities.

And South African's Blue Diamond first class or Gold Medallion economy service lets your African adventure begin the moment you step aboard one of our Stratojets.

You'll love getting there. And we'll love getting you there.

SAA

SOUTH AFRICAN AIRWAYS

To the land of wonderful contrasts.

NEW YORK, 605 Fifth Ave./CHICAGO, Suite 2106, 67 E. Madison St./HOUSTON, Suite 1519, 1100 Milam Building/LOS ANGELES, 606 S. Olive St.
SAN FRANCISCO, 360 Post St./TORONTO, Suite 2610, P.O. Box 195, Toronto Dominion Center, Royal Trust Tower

Photographer: David Hamilton Camera: Minolta SR-T 101

Sometimes it's easier to see a photograph with your eyes closed. Then your imagination can run free.

When your mind creates an image, the interpretations of it are infinite.

Is David Hamilton's photograph a childhood memory? Is the girl listening to a voice coming from the sea?

You can see more of Hamilton's imagination in his book, "Dreams of a Young Girl."

There's a visual wealth to be discovered inside everyone.

To uncover it, just close your eyes.

To capture it on film, choose a camera that lets your mind express itself.

What happens inside your mind, can happen inside a camera.

With a Minolta SR-T 101, nothing interrupts David Hamilton's photographic stream of consciousness. Without looking away from the viewfinder, Hamilton can compose, focus, adjust shutter speed and lens opening. A scale shows the exact shutter speed setting from 1 to 1/1000th second plus "bulb". And the finder is always at maximum brightness until the moment of exposure. Lens changing is equally effortless. Sturdy bayonet mount. No aperture or ASA settings to re-align. And you can choose meter-coupled Rokkor lenses ranging from fisheye to long-range telephoto. Minolta SR-T cameras are equipped with a patented "CLC" through-the-lens metering system that automatically compensates to prevent under-exposure of dark areas in high contrast situations.

When identified by a factory-sealed "M" tag, Minolta 35mm reflex cameras are warranted by Minolta Corporation against defects in workmanship and materials for two years from date of purchase, excluding user-inflicted damage. The camera will be serviced at no charge provided it is returned within the warranty period, postpaid, securely packaged and including $2.00 for mailing, handling and insurance.

For literature, write: Minolta Corporation, 200 Park Avenue South, New York, New York 10003. In Canada: Anglophoto Ltd., P.Q.

Minolta

NATURAL HISTORY

JUNE-JULY 1974 • $1

Three new signed works of art by Waterford.®

What's new in objets d'art?

These three patterns.

Three new signed originals to join the legendary collection of crystal from Waterford.

Hold each to the light and you can see faintly etched the signature that identifies it as an authentic work of art.

No other crystal is so brilliant. Born in white hot heat, it reflects the glory of the distant past.

Every single facet is cut by hand in Ireland, just the way Waterford museum pieces were cut long years ago.

Glengarriff, $13.25

Comeragh, $13.25

Kildare, $11.50

Investments in timeless beauty, born of the heritage that is Waterford's alone.

Visit the Waterford gallery at the important store in your area. Or write for free full-color booklet. Waterford, 225 Fifth Avenue, New York 10010.

Isn't it time you started collecting signed originals by Waterford?

And when the bell rings, bring out Aynsley English Bone China, ideal dinner companion for Waterford.

Photos Pesin

NATURAL HISTORY

Incorporating Nature Magazine
Vol. LXXXIII, No. 6
June-July 1974

The American Museum of Natural History
Gardner D. Stout, President
Thomas D. Nicholson, Director

2 Authors

4 Letters

10 Bios: The Ungreening of South Vietnam
Arthur W. Galston
The consequences of massive, unprecedented chemical warfare against the environment.

16 This View of Life: Darwin's Dilemma
Stephen Jay Gould
Evolution does not mean progress.

24 Caves of the Infinite Buddhas
Judith M. Treistman
Emperors and peasants have journeyed to these ancient monuments in remote northern China.

34 When the Turtle Collapses, the World Ends
Bernard Nietschmann
A hapless tribe of Indians and the green turtle are sinking together.

44 Guns of the Tau Sug
Thomas M. Kiefer
The roots of the Muslim uprising go deep in the Philippines.

52 Celestial Events
Thomas D. Nicholson

54 The New Town Bird Quadrille
Aelred D. Geis
An architect, unwittingly, can be a bird's best friend.

62 Sky Reporter: Are We Alone in the Cosmos?
Robert Jastrow

66 The Rise and Fall of Heroin Addiction
Robert L. DuPont
Why did the worldwide drug epidemic peak in the late 1960s?

72 Home Is Where the Hearth Is
A review by Edward Abbey
"A book of homes, *habitations for human beings in all their infinite variety."*

76 Announcements

78 A Matter of Taste: The Turn of the Ewe
Raymond Sokolov

83 Additional Reading

Cover: *A chipping sparrow carries lining material to its nest in an apple tree. In the new town of Columbia, Maryland, this species has increased because of the availability of suitable trees for nest sites, grass seeds to feed on, and ornamental shrubs for shelter. Photograph by Thase Daniel, Bruce Coleman, Inc. Story on page 54.*

Alan Ternes, Editor
Thomas Page, Designer
Board of Editors:
Sally Lindsay, Frederick Hartmann,
Christopher Hallowell, Toni Gerber
Carol Breslin, Book Reviews Editor
Florence G. Edelstein, Copy Chief
Karen Bierstedt, Copy Editor
Angela Soccodato, Art Asst.
Diane Pierson, Editorial Asst.
Lillian Gindea

Rosamond W. Dana, Publications Editor

Editorial Advisers:
Dean Amadon, Dorothy E. Bliss,
Mark Chartrand, Niles Eldredge,
Vincent Manson, Margaret Mead,
Thomas D. Nicholson, Gerard Piel,
Richard G. Van Gelder

David D. Ryus, Publisher
L. Thomas Kelly, Business Manager
Ernestine Weindorf, Administrative Asst.

Ann Brown, Circulation Manager
Joyce E. Klutch, Asst.
Joan Mahoney
Harriet Walsh

Harvey Oshinsky, Advertising Sales Manager
Gordon Finley
Harry R. Jeter
Vic Asselin
Eileen O'Keefe, Production
Cynthia Dawson, Asst.

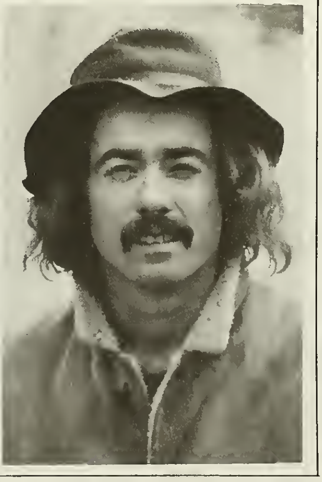
Publication Office: The American Museum of Natural History, Central Park West at 79th Street, New York, N.Y. 10024. Published monthly, October through May; bimonthly June to September. Subscriptions: $8.00 a year. In Canada and all other countries: $10.00 a year. Single copies $1.00. Second-class postage paid at New York, N.Y., and at additional offices. *Copyright © 1974 by The American Museum of Natural History. No part of this periodical may be reproduced without the written consent of* Natural History. *Manuscripts and illustrations submitted to the editorial office will be handled with all possible care, but we cannot assume responsibility for their safety. The opinions expressed by authors are their own and do not necessarily reflect the policy of The American Museum.* Natural History *incorporating* Nature Magazine *is indexed in* Reader's Guide to Periodical Literature.

Change of address notices, undeliverable copies, orders for subscriptions, and other mail items are to be sent to Natural History Magazine, Membership Services, Box 6000, Des Moines, Iowa 50306.

Authors

Bernard Nietschmann made his first trip to Central America in 1965 to study the social, economic, and ecological consequences of the overexploitation of the green sea turtle. The project, centered in Mexico, eventually led him to research the Miskito Indian–green turtle subsistence system in eastern Nicaragua. He is now engaged in a National Geographic Society tagging program designed to determine the migration patterns of the hawksbill turtle. A recently completed venture has been the co-production with his wife Judi of a documentary film on the Mexican revolution and the social and economic changes it created. Nietschmann is an associate professor of geography at the University of Michigan.

It was by accident that **Thomas M. Kiefer** began studying the Tau Sug in the southern Philippines. He had planned to do anthropological field work in Indonesia while working toward his doctorate, but the political situation there prevented him from beginning his research. As an alternative, he chose the Philippines, where he learned of the independent and violent attitudes of the Tau Sug. For two years he lived with them, filmed them, and recorded their music. In 1972 he published a monograph, *The Tausug: Law and Violence in a Philippine Moslem Society*. Presently teaching anthropology at Brown University, Kiefer plans to study comparative legal reasoning at Harvard University Law School.



An interest in the early history of Southeast Asia and China has taken **Judith M. Treistman** to Thailand, where she did archeological work, and Taiwan, where she researched aboriginal history. She is currently studying archeological materials and artifacts from many sources in an attempt to analyze the role of

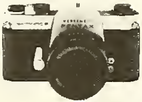
When plans were announced in the mid-1960s for construction of the "new city" of Columbia, Maryland, **Aelred D. Geis** recognized an ideal opportunity to study the effects of urbanization on bird populations. An urban bird specialist with the Patuxent Wildlife Research Center in nearby Laurel, Maryland, he began recording the changes in numbers and diversity of the resident bird species and identified the factors responsible for significant shifts as the planned community developed. Building on the base line of data generated in 1966, Geis is continuing his work on the population dynamics of birds in urban environments.

ideology in prehistory. Author of the book *The Prehistory of China*, "The New Archeology of China" (*Natural History*, August-September, 1972), and of numerous other articles on Oriental archeology, Treistman is associate professor of anthropology at the City University of New York Graduate Center.

Seven years ago, at the age of thirty-one, psychiatrist **Robert L. DuPont** had to decide how to apply his years of medical training. Having worked briefly at a prison and finding that "there are few parallels in medicine to the experience of helping free heroin addicts from their habit so they can rebuild themselves," he chose to center his career on the treatment of addicts. DuPont worked first as a research psychiatrist in the District of Columbia Department of Corrections and then became administrator of the D.C. Narcotics Treatment Administration. Today he is director of the Special Action Office for Drug Abuse Prevention, and director of the National Institute for Drug Abuse.

Paint by shutter.

It's easy with the new Honeywell Pentax Spotmatic F. This is the camera designed for action. Just focus, center the needle and shoot. You'll get great photos—sharp, vibrant, filled with excitement. And when you're ready to expand your creativity, there are scores of lenses and accessories in the Pentax system. Discover the new Spotmatic F at your nearest Honeywell photo dealer. Or for FREE brochure on this and other fine Pentax cameras, write to us. Honeywell Photographic, Dept. 113-447, P.O. Box 22083, Denver, Colorado 80222. In Canada, McQueen Sales Ltd., a Honeywell subsidiary.



Honeywell Pentax

Honeywell Pentax in the U.S and Mexico Asahi Pentax elsewhere

Hidden in Africa, a 4,000-year-old culture called Ethiopia.

We've been here with our castles and churches, our paintings and jewels, our rare wild life and birds for centuries. Hidden by natural barriers. Now the treasure chest is being opened. Call your travel agent or mail the coupon for information about the Hidden Empire.

ETHIOPIAN AIRLINES 200 E. 42nd Street, New York, N.Y. 10017 Tel. (212) 867-0095 Dept. HN-13

Name

Address

City State Zip

ETHIOPIAN AIRLINES
The key to the Hidden Empire

I'll drink to that.
KAHLUA
COFFEE LIQUEUR
PRODUCT OF MEXICO

KAHLÚA®
Splash.
What a
fresh idea.

An ounce of Kahlúa, a splash of soda, a squeeze of lime on the rocks. No simpler way to give the cocktail a whole new twist.
Do send for the Kahlúa Recipe Book. Our treat. Because you deserve something nice.

Kahlúa. Coffee Liqueur from Sunny Mexico.
53 Proof. Jules Berman & Assoc.,
116 No. Robertson Blvd., Los Angeles, Calif. 90048

Letters

Evolution under Attack

Dr. Newell ["Evolution under Attack," April, 1974] presents his case effectively, if not fairly. He first raises the specter of the Scopes trial and the banner of academic freedom, then identifies all professional experts with the Darwinian position and speaks of the creationists as "small . . . fundamentalist groups" (church membership of 20 million is small?), and finally defines the Darwinian dogma in its most innocuous terms ("profound changes in organisms throughout the history of life"—that's not the way the high school biology teacher tells it, brother!). The fundamental creationist position, according to Dr. Newell, is belief that the universe was created in 4004 B.C., presumably in six 24-hour days.

Many religious people don't believe the beginning took place 6,000 years ago but are still unhappy with the Darwinian dogma being force-fed to their children in the public schools.

My objections to Darwinism are simply that it is neither true nor useful. It is partly evidence (species do change—sometimes mere variation, sometimes mutation; rock strata have been laid successively; radioactive materials decay at certain rates), partly conjecture (all species have a common ancestor, the process took 10 billion years, it all began with a "hot, thin soup"), and partly sheer atheology ("a nucleic acid molecule learned to replicate"; it was all pure chance; man is just another life form). However, it is presented to students and the general public as fact; or at best, called a theory but clearly identified as the only acceptable theory for educated people.

If the theology of Moses and Christ is by law excluded from the public schools, then the atheology of Darwin must also be excluded, and its conjectures plainly labeled.

The rise of Darwinism as a philosophy of life has coincided with the spread of nihilism, moral indifference, and cynicism in Western society. It is the foundation for the most destructive ideas and aims of our time and saps the will of even well-intentioned people to stand up for anything. By contrast, Judaism and Christianity, in spite of their aberrations, have demonstrated their usefulness for centuries.

Today, after 100 years, Darwinism is in retreat, not because it has been proved wrong, but because its value is seriously questioned, and people are growing tired of it. Hence, the popular faith in creation, never wholly subdued, reasserts itself.

DONALD V. ETZ
Kettering, Ohio

What distresses all Christians, I think, not merely fundamentalists, is that the theory of evolution is always—or nearly always—presented as one that renders "that hypothesis [God]" unnecessary. One can believe in the God of the Nicene Creed, who is creating the universe, and that "evolution" is the method by which he is doing it. I can see no logical inconsistency in holding both beliefs at once.

F. WARREN MORRIS
Winston-Salem, North Carolina

Dr. Newell has made a fine, lucid, and understandable defense of the theory of evolution.

But there is no use in arguing from the facts of biology or geology when addressing a special creationist, no matter what fancy "science" titles he may have. The only way to rebut him is by a *reductio ad absurdum.* It is by the making of a statement: "All things, including the minds of men, their memories, and their preconceptions, were created only one second ago."

Not one special creationist alive can disprove this statement, and his

Before the wind rises or the tide changes or somebody throws a rock into your moment, use a Minolta SR-T camera to make it part of you.

You're comfortable with a Minolta SR-T from the moment you pick it up. This is the 35mm reflex that lets you concentrate on mood and insight. The viewfinder gives you all the information you want for focusing and exposure. Because you never have to look away to adjust a fast-handling Minolta SR-T, you're free to catch the one photograph that could never be taken again.

The SR-T 101 lets you use microprism focusing with a ground glass collar. A scale in the viewfinder shows your shutter speed, from 1 to 1/1000th second, plus bulb.

The SR-T 102 gives you split screen focusing with a microprism collar, and adds an aperture read out to the shutter speed scale in the viewfinder. And the SR-T 102 makes it easy to get deliberate multiple exposures with remarkable accuracy.

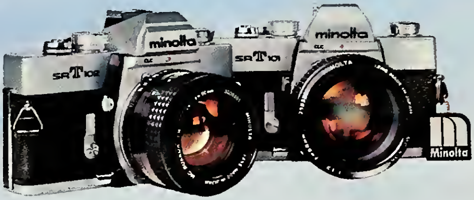
All Minolta SR-T cameras give you the patented "CLC" through-the-lens metering system. It protects you from under-exposure by automatically compensating in high contrast light. Meter-coupled Rokkor lenses stay at maximum aperture, so the finder is always at full brightness until the moment of exposure.

When you see something that needs a different perspective, just snap on one of the complete system of Rokkor lenses from super-wide 16mm to super-long 1600mm, plus zoom and macro lenses. It takes just seconds, with no ASA or f/stop realignment to waste your time.

Try a Minolta SR-T camera. You've kept your ideas to yourself long enough.

For more information, see your photo dealer or write Minolta Corporation, Consumer Products Division, 200 Park Avenue South, New York, N.Y. 10003. In Canada: Anglophoto Ltd., P.Q.

Minolta SR-T 101/Minolta SR-T 102



Minolta helps you keep the peace.

When identified by a factory-sealed "M" tag, Minolta 35mm reflex cameras are warranted by Minolta Corp. against defects in workmanship and materials for two years from date of purchase, excluding user-inflicted damage. The camera will be serviced at no charge provided it is returned within the warranty period, postpaid, securely packaged and including $2.00 for mailing, handling and insurance.

When the two images become one, you're in perfect focus. Only Sankyo Hi-Focus has it.

Most movie cameras have ground glass focusing or guess-the-distance scales. Frankly, they're darned hard to focus.

But then, there's Sankyo Hi-Focus. A whole series of automatic movie cameras with big, bright through-the-lens superimposed rangefinder image that virtually guarantees needle sharp movies. You can focus precisely, in seconds, even zoom in on a moving subject. As you look through the viewfinder, the subject appears as two images. Just turn the zoom lens until the two images become one...and you're in perfect focus. It's that simple. The closest thing to automatic focusing! There's a Sankyo Hi-Focus movie camera with your kind of features and your kind of price tag at your camera dealer now.

Sankyo

Sankyo Seiki (America) Inc.
149 Fifth Avenue, New York, N.Y. 10010
West Coast Branch:
13000 S. Athens Way, Los Angeles, Calif. 90061

own (like) statements are thus cast into utter doubt.

Dr. Newell's fine reportage causes me to think that the special creationists are attempting to establish a *de facto* state religion to be taught in the public schools. Shame! What of those who adhere to the American Indian version of the Creation? Or, the Buddhist version?

Hiram F. Gutgasz
Yorktown Heights, New York

Newell fails to define the precise area of conflict between evolutionists and special creationists—presuppositions. The discussion is not one of scientific evidence versus special creation; it is rather one of presuppositions governing explanations of the hard data supplied by the scientific method. Newell writes, "Like everything in science, the theory of organic evolution is open to revision should new evidence appear." But is the theory of organic evolution open to revision should new presuppositions appear? To his assertion, "The doctrine of special creation is theology, not science," I suggest that the theory of organic evolution is philosophy, not science.

Editor's Note: *In our next issue we will print additional letters about the evolution controversy, along with Dr. Newell's response to the issues raised in them.*

Dale Younce
Borger, Texas

It is a shame that groups would seek to discount the vast body of scientific knowledge that has been ours only in the past 50 to 100 years. Theology, too, has benefited from scientific discoveries of the same period, especially archeology, and we know more than the theologians of the Middle Ages and before, and we can interpret better than they could on the basis of the store of knowledge.

Quite likely, 100 years from now there will be more knowledge, and our theories will be questioned. We may be considered poets, just as the writers of Genesis explained the origins of life from their perspective; just as the tellers of the Tale of Gilgamesh spoke from theirs.

Rev. William B. Gray
New York, New York

In Praise of Cities

In his otherwise fine review of the Rockefeller Brothers Fund report, *The Use of Land* (April, 1974), Gladwin Hill says: "Today most of the nation's population is jammed into less than 10 percent of its land area, while 90 percent of the land remains relatively unused. . . . This maldistribution is manifest idiocy, and a start on remedying idiocy can't be made too soon."

Far from being "idiocy," the present distribution of population in the United States represents a complex system of metropolitan communities, which has shown regularities throughout the history of the nation. Metropolitan communities form a nationwide system, linked by ties of transport and communication, a mobility of people, jobs, goods, services, information, money flows, and capital—all without governmental restrictions on movements.

It is misleading, if not nonsense, to suggest that "90 percent of the land remains relatively unused." The rural land area of the country is intensively used for farming, grazing, and forestry.

While it may be intuitively appealing to house the expected addition of 60 million Americans between now and the year 2000 in isolated "new communities," far from present metropolitan areas, it is not necessarily analytically sound. People move to existing urban regions to seek gains in their real income. Even the poor blacks who moved from southern farms between 1940 and 1970 experienced significant income gains after five years. Isolated new communities can be built, but they will be extremely costly in new community services, and people may not wish to live in them.

It is perhaps chic these days to become fascinated by the pathology of urban regions, and particularly the conurbation of the eastern seaboard studied by Jean Gottmann. Nevertheless, the French author of *Megalopolis* (1961) warned: "The picture . . . is not as dark as the outspoken pessimists and frequent protests would seem to paint it. Crowded within its limits is an extremely distinguished population. It is *on the average*, the richest, best educated, best housed, and best serviced group of similar size

This is a uranium mine. Today you see it. Someday you won't.

This is an Exxon mine near Casper, Wyoming. It holds one of the largest deposits of uranium discovered in America in recent years.

The mine processes about 14,000 tons of ore a week. The valuable uranium material in the ore is the base ingredient Exxon uses to fabricate fuel elements. The fuel elements are supplied to nuclear power plants that generate electricity to meet today's energy need.

Within six to ten years, most of the uranium will be extracted, and we'll be finished here. But when that day comes, we won't just pull up stakes and pull out.

Almost all the area you see above will be filled in. The land will be contoured to match the adjacent countryside. Then it will be planted.

And someday, if you stand on the spot where our picture was taken, about all you'll see are gently rolling hills, a lake, and perhaps a flock of sheep, or an occasional deer or antelope.

This isn't just something we're going to do. Our reclamation program started before we took the first shovelful of earth out of the mine.

The material we removed to get down to the uranium was spread nearby, contoured and planted. And in 1971, the first grass, shrubs and wildflowers appeared.

Now don't get the impression that we think surface mining is beautiful. It's far from it—as you can see. The beautiful thing is that while today you may see it, Exxon's making sure that someday you won't.

EXXON

We'd like you to know.*

*Service mark of Exxon Corporation

You can take pictures or you can *make* pictures

Whether or not you're traveling less these days,* you probably know better than some that in a backyard, in a nearby park, just off a familiar path, there is plenty to see and appreciate. Somehow a camera in front of your eye forces you to take the trouble to see the beauty just right.

The result helps fit it all into place, and it needn't be stowed away for just an occasional showing. Big prints in color bring in the real world to make the place where you live beautiful. The satisfaction of making them yourself can add considerably to the pleasure.

For a start in that direction, send a self-addressed envelope prominently marked "A3-75" to Kodak, Dept. 55S, Rochester, N.Y. 14650. We'll send you a guide to Kodak literature for all levels of photographic experience. Or a photo retailer can recommend a photo lab with a reputation for quality in color prints of generous size.

Kodak

---

*At Spokane, Washington this summer, we are at Expo '74 to preach the doctrine "Know the land and the people" with few words and such imagery as above. Public transportation is available from far and near. It's a World's Fair with pavilions from other nations, entertainment, and celebration of the natural environment.

(i.e., in the 25 to 40 million people range) in the world."

CARL H. MADDEN
Chief Economist
Chamber of Commerce
of the United States

The Race Problem

Multivariate analysis is indeed a more stimulating discipline than static taxonomy, and if the term "geographic variability" is less disturbing to Dr. Gould ["The Race Problem," March, 1974] than the naughty word "race," let us by all means restrict our terminology to polysyllabic euphemisms.

To suggest, however, that the anatomical, physiological, and psychological variations that exist between the historical inhabitants of Asia, Africa, and Scandinavia, geographic variables though they be, are nonexistent, or that they do not constitute taxonomic (and by inference, genetic) differences, seems to me unscientific or even muddleheaded.

ROBERT K. BUCK, M.D.
Waban, Massachusetts

THE AUTHOR REPLIES:

An author can offer very little defense against careless reading of his words. May I simply quote from my own article: "Geographic variability, not race, is self-evident. No one can deny that *Homo sapiens* is a strongly differentiated species; few will quarrel with the observation that differences in skin color are the most striking outward sign of this variability. But the fact of variability does not require the designation of races. There are better ways of studying human differences."

The Unheard Voices

If Stephen Jay Gould had pointed out ["The Nonscience of Human Nature," April, 1974] the dangers of extrapolating broad theories of biological determinism from a core of probable truth, recognizing that there *is* such a core, I would have no argument with him. Instead, he commits the crime of which he accuses his adversaries, but from the opposite direction—he argues for nothing short of a thoroughly relativistic, environmentalist view of man and culture, and rules out preprogramming altogether.

Gould overstates his case, I believe, precisely because of social and political pressures which abound nowadays in the academic world. To argue that *all* behavior is willful, and therefore changeable, is the orthodoxy of the women's movement, among others—groups that, logically enough, are based on the assumption that changes in behavior may be effected to secure social or political justice. It is possible to grant such groups their arguments without branding "biological determinism" as some sort of bogeyman, which is being used, universally it seems, by self-seeking pseudoscientists to maintain the status quo.

I personally would very much hate to see anyone who happened to be investigating preprogramming, as a possible means of understanding culture, labeled out-of-hand as a "biological determinist," who presumably thinks that women and blacks are biologically inferior and that all men are naturally aggressive. I hope that is not what Mr. Gould intends, but if it is, I oppose him.

I have heard the argument that some ideas should be suppressed because of their great susceptibility to being misused, but I cannot buy it. Until someone undertakes a serious response, it will always be the Shockleys whose voices are heard, even above the shouting. It is most often the serious researchers who end up being stifled—the very ones who are most likely to be able to point out the errors of those who overgeneralize or misinterpret.

But when overgeneralization or misinterpretation occurs, there seems always to be a tendency for some to demand that future research should be devoted only to disproving the charlatans, rather than simply investigating the phenomena. I suspect that the main problem with Jensen and Shockley right now, for instance, is that there are too many people doing research with a view toward disproving their theories—and not enough simply looking at the data to see what is revealed.

JAMES P. GIRARD
Lawrence, Kansas

ERRATUM: In the article, "Atmospheric Titan," by Gregory Benford (April, 1974), carbon dioxide was mistakenly grouped with light gases when, in fact, it is heavier than methane and ammonia.

BEAUTY
BEGINS
HERE...

in nature, in the trees that give charm to your house and shade to your garden. That's where you'll find it. But healthy, beautiful shade trees don't just happen these days. Continued poor environment, attacks by disease and insects often kill or disfigure the ones we value most. Much of this loss can be avoided, however, by accurate diagnosis and the timely use of scientific methods.

These problems are not new to us. Long before their ecological condition was thought to be so serious we were spending substantial amounts of time, talent and money in research to help save America's trees.

If you are concerned about your trees, call your local Bartlett representative today and let him show you not only how scientific care will make them more beautiful, but how it will keep them that way.

BARTLETT
TREE EXPERTS

Home Office, 2770 Summer Street,
Stamford, Conn. 06905

Research Laboratories
and Experimental Grounds,
Charlotte, N.C.

Local Offices from Maine to
Florida and west to
Illinois and Alabama.

by Arthur W. Galston

The Ungreening of South Vietnam

Controversy over the former United States defoliation program continues to smolder despite the official end of the war

After several delays and considerable acrimony, a blue-ribbon committee appointed by the National Academy of Sciences has released a report entitled "The Effects of Herbicides in South Vietnam." Under the directorship of Anton Lang, a plant biologist at Michigan State University, a seventeen-man group of assorted biological scientists and anthropologists, backed up by a professional staff and thirty consultants, spent more than 1,500 man-days in South Vietnam and worked for about three years to compile the report it delivered to Philip Handler, President of the National Academy of Sciences. Handler, in turn, gave copies of the report to the President of the Senate, the Speaker of the House, and the Secretary of Defense. The latter official was included because the Department of Defense footed the bill for the study; however, anthropologists refused to work under Defense Department auspices, so the National Academy used some of its own funds to support their efforts. The study arose from a background of controversy; a controversy that continued throughout the study and ultimately found its way into the final report, from which three committee members dissented on important issues.

Early in the Vietnam war, military experts sought ways to reduce the damage done to our equipment and personnel by guerrillas entrenched in dense undergrowth. The experts also sought to expose to aerial attack forces infiltrating from the North and to kill selected crops in certain outlying areas, thus, presumably depriving guerrilla units of food. For these purposes, the military used chemical defoliants developed after World War II, but never before used in warfare. When applied in appropriate concentrations, these synthetic defoliants, which are analogues of the growth hormones present in plants, cause trees to shed their leaves several days after exposure. The same compounds can be used to selectively kill herbaceous plants, much as the American gardener uses 2,4-D to kill dandelions on a grassy lawn without killing the grass itself.

In Vietnam, the effective defoliants were delivered from converted cargo planes carrying huge tanks with nozzles controlled by the pilots. The main chemical employed, Agent Orange, is approximately a one to one mixture of two common herbicides, 2,4-D and 2,4,5-T. Two other herbicides, picloram and the arsenic-containing cacodylic acid, were used on a much smaller scale. In the United States, 2,4-D and 2,4,5-T are applied at the rate of about 0.5 to 2.0 pounds per acre, but in Vietnam, the rate approximated 25 pounds per acre. In all, approximately 100 million pounds of assorted herbicides were sprayed over five to six million acres, an area approximately the size of the state of Massachusetts. Never before had such massive chemical warfare been employed against the environment. That fact, together with the tropical locale, prompted many scientists in the mid-1960s to express their fear that herbicides would cause enormous ecological damage in Indochina. Acting independently at first, they goaded the American Association for the Advancement of Science into appointing a Herbicide Assessment Commission, under biologist Matthew Meselson of Harvard University, to estimate the damage. This committee delivered an interim report in 1970 but has yet to make its final report. In the meantime, the Department of Defense, responding to pressure, had commissioned an independent search of the relevant literature by the Midwest Research Institute of Kansas City, a private research consulting organization. Unhappy with the interim statement of the Meselson group and in response to a 1970 Congressional charge, the Defense Department still later moved to finance the National Academy of Sciences' study.

What were the main conclusions of the National Academy study, and why does the acrimony continue?

Think of it as a professional recording studio in your home.

There are two basic factors most people consider when buying a tape deck. Its capabilities and its cost. They weigh one against the other in terms of their specific requirements.

That's why Pioneer's RT-1020L is so popular. This 3-motor, 3-head deck has virtually every professional feature you'd want, yet it's priced well within the means of the home recording buff.

The RT-1020L gives you optimum sound reproduction from any tape on the market with a 3-step bias selector. And when you're recording from old records, you'll be astonished at the way the equalizer selector polishes up their highs.

Its click-free full logic pushbutton controls prevent jamming and spilled tape, even when switching directly from the Record mode to Fast Rewind. You can do this without touching the Stop button, thanks to the sophisticated logic circuit.

Whatever you're looking for in the way of capability, the RT-1020L has it. In fact, Pioneer has built in more features than any other tape deck in its price range — 2 & 4-channel playback, 10½-inch reels, pause control, sound-on-sound, sound-with-sound, Mic/Line mixing, 7½ & 3¾ ips speeds, and so much more.

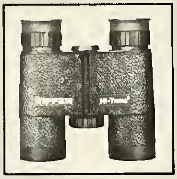
Check any tape deck that's priced around nine hundred dollars. Then compare it with the RT-1020L. You'll be amazed at how much Pioneer has packed into this unit at $649.95. It's an absolutely unbeatable value.

Also available: the RT-1020H (15, 7½ ips) at the same attractive price.

U.S. Pioneer Electronics Corp.,
75 Oxford Drive, Moonachie,
New Jersey 07074
West: 13300 S. Estrella, Los Angeles
90248/Midwest: 1500 Greenleaf,
Elk Grove Village, Ill. 60007/Canada:
S.H. Parker Co.

PIONEER®
when you want something better

PIONEER
1
PIONEER
1
PIONEER
3-MOTOR 3-HEAD STEREO TAPE DECK
POWER
REEL
SPEED
MIC
LINE
INPUT
REC
PLAY
METERS
MONITOR
TAPE PLAY
SOURCE
BIAS
EQ
PHONES
OUTPUT
FRONT
REAR
LEFT
MIC
RIGHT



Tiffen can help you learn about the birds and the bees.

Tiffen makes compact high quality Hi-Trans® binoculars designed with the outdoorsman in mind. And our unique Roof Prism Optical System is of such fine quality and durability, you'll find them only where fine cameras are sold. And at a price much less than you'd expect.

Ask to see all five models of Tiffen Hi-Trans® binoculars. And from then on, no matter which pair you choose, you can get as close to nature as you want. Write for literature.

Tiffen. The binoculars with camera quality lenses.

TIFFEN
Manufacturing Corp.

75 Jane Street
Roslyn Heights, N.Y. 11577

Handsome Headpiece for Top Hands Ramrods and Dudes

To keep you cool headed and jauntily comfortable, we've had the STETSON people duplicate the famous Eddie Bauer DERRINGER in fine Panama Straw. Total weight 2¼-ounces! The 3-inch edgebound brim has the distinctive upward roll seen only on hats made to order for ranchers in the Southwest. The headband is colorfully woven in authentic Apache tribal patterns. Sizes: 6¾-7¾. Color: Straw Gold. **No. 1965** Featherweight DERRINGER ppd. **$11.95.**

Order today! Money-back guarantee!

Enclosed is my check or money order for
$______(Add sales tax where applicable.)
Please RUSH my Eddie Bauer Featherweight DERRINGER. No. 1965 Size______
Name______
Address______
City______
State______Zip______
☐ Send me FREE your new color catalog of over 1000 great outdoor products.

Eddie Bauer®

Dept. LNH, 1737 Airport Way S., Seattle, Wa. 98124

There is relatively little controversy about some of the facts. For example, it seems clear that the extensive mangrove forests in the estuarine zones of Vietnam were extraordinarily sensitive to Agent Orange and frequently succumbed to a single spraying. The Academy report estimates that 36 percent of all the mangroves of South Vietnam, representing 0.6 percent of the total area of that country, have been killed by defoliating chemicals. Because the mangrove community is an extraordinarily rich and important ecological complex, one in which many fish and shellfish complete a portion of their life cycle, this destruction alone is certain to have a profound impact not only on the ecosystem but also on the nutrition of the human population. Since the report estimates it will take a century or more for the mangroves to come back naturally or, optimistically, twenty to thirty years with some help from man, the damage is not apt to be temporary.

The main controversy concerns damage done to the extensive inland forests, which spread over about twenty-six million acres, or almost two-thirds of the entire country. At least 10 percent of that area, or 6.5 percent of all of South Vietnam, was subjected to one or more defoliation operations. How much damage was done by those actions? This is where the committee split into uncompromisingly dissenting factions. Ordinarily, an estimate of damage could be easily obtained by on-site measurements of total tree population and killed members. But in Vietnam this method is impossible since much of the sprayed territory remains under the control of either the Provisional Revolutionary Government or forces allied with it, which would not look with favor on a visit sponsored by the Defense Department of the United States. Faced with the problem of conducting ecological surveys on the ground at great danger to life and limb, the committee decided to resort to aerial surveys. Aerial photo-ecology is now a well-recognized field, and many important conclusions about plant populations can be drawn from clear and properly interpreted photographs. Why, then, the acrimony and disagreement? One difficulty is that many dead trees become overgrown with tropical vines, giving the photographic impression that they are still green and alive. Thus, the dissenters from the report, as well as Meselson and two other Academy report reviewers, feel that the damage was underestimated, perhaps as much as twentyfold. Paul W. Richards of the University of North Wales at Bangor, Great Britain, a world-recognized expert on tropical rain forests and an invited member of the committee of inquiry, says in his dissenting statement: "(1) the methods used led to a serious underestimate of the number of dead trees in the 1972–73 photography, much of which was of indifferent quality, (2) there was an inadequate appreciation of the postmortem changes to which trees are subject in humid tropical climates. Because of these changes, counts of dead trees and estimates of crown and tree diameters in air photographs taken long after the death of the trees may be very unreliable." The question of forest damage thus remains unresolved.

The social consequences of the spraying operation transcended even the damage to plants. Some communities in the path of defoliation operations were sprayed repeatedly. The resultant loss of agricultural productivity led to the abandonment of fields and ultimately to the displacement of entire village populations to urban relocation centers. This was especially true of the mountain-dwelling Montagnards. Their villages may never be reoccupied. Psychological reactions were also common. The report's summary says: "Refugees from a rural community, which had been heavily sprayed, showed a higher level of emotional strain than any other group to which they could be compared." Even in the cities "our study of pro-government and opposition newspapers from Saigon showed that the military herbicide program came to be viewed negatively by the people. . . . Herbicides came to be an emotionally charged symbol standing for many apprehensions and distresses, especially those for which Americans are blamed."

One controversial issue on which the National Academy report sheds no light at all is the possible direct damage to humans from herbicides. It is now known that most samples of 2,4,5-T, including those used in Vietnam, are contaminated with

Eight wild safaris properly tamed by British Airways.

Africa. The very word inspires fierce images of wild animals and jungles dense with 12-foot plants. We'd like you to see that Africa—from safe vantage points, of course—on your choice of eight wildly exciting but comfortably tamed African tours.

On one, you'll soar over herds of wild beasts in a private plane. On another, you'll explore vast craters and deserts in a sturdy Land Rover. Some nights you'll sleep under African stars in the finest, weather-proofed canvas tents. And you'll take thrilling close-up photos of lions, giraffes and rhinos from your lodge veranda.

So this year, consider our Africa. We've properly tamed the prices too.

Value Safari

15 days $1679—$1738. Journey through Kenya and Tanzania. With the Masai Mara Game Reserve, Ngorongoro Crater, Kilimanjaro, hotels, meals and more. Good action. Good value.

East African Wing Safari

23 days $3042—$3120. Fly over plunging waterfalls, snow-topped Kibo, crocodiles and hippos in a 3-engine private plane. Hotels and meals included.

Famous Lecturer Safari

23 days $1691—$1801. Explore East Africa's fascinating wildlife with world-famous experts on our Big Game & Birds Safari. Or mix in a little Beach & Treetops or Nyeri & Treetops Safaris. All with lodgings and meals, naturally.

Trans Africa Safari

57 days $1863—$1972. Modern Land Rovers and an AfrikaBus speed you through the Sahara Desert in Algeria down to Nairobi on an eight-week journey you'll never forget. Too much to talk about here. We also have a month-long safari through Kenya and Ethiopia and two other African Safaris in this group. At relatively modest prices.

Call of Africa Safari

22 days $2239—$2300. Kenya's famed game reserves and Treetops Hotel, South Africa's National Parks, Rhodesia's Victoria Falls and the Serengeti Plains in Tanzania. All combined with meals, hotels and everything you can think of.

Africa Under Canvas Safari

21 days $2387—$2465. Explore Kenya's parks, game reserves and more, alternating your nights between comfortable lodges and sleeping outdoors in attractive campsites. For purists only.

African Sasafari

21 days $2800—$2861. A flying safari in private planes to the great wild game areas of East Africa, frontier Botswana, Mozambique, Rhodesia and South Africa. Comfortable tent camps and tree lodges. Kenya's famous Treetops. Lodgings and meals, of course.

East African Wild Life Society Safaris

21 days $2198—$3575. (Including membership.) A series of highly unusual safaris sponsored by this well-known society. Leading animal experts escort you gorilla stalking, hiking, and show you unusual game parks. Special departures for artists and photographers.

Tour prices shown are for each of two in minimum hotel category. Tour prices include 14/45 day economy excursion fare, 22/45 day economy excursion fare or 14/21 day Group Inclusive Tour fare, from New York. Subject to minimum 15 passengers. Bookings must be made at least 15 days prior to departure. Surcharges for weekend travel and supplemental charges for individuals travelling alone.

For more on how we've tamed the wild African tour, call your Travel Agent or British Airways for dates, prices and details. Even on Safari, you'll find we take good care of you.

British Airways
Box VC10, Department 151-1540.
New York, New York 10011. Tel: (212) 687-1600.

I'd like more information on your wild but properly tamed safaris. Please send me the following brochures.

☐ Value Safari ☐ East African Wing Safari
☐ Lecturer Safari (On Safari) ☐ Trans Africa Safari
☐ Call of Africa ☐ Africa Under Canvas Safari
☐ African Sasafari ☐ East African Wild Life Society Safaris

Name ______________________

Address ______________________

City ______________ State ________ Zip ________

My Travel Agent is ______________________

We'll take good care of you to Africa. Europe. The World.

British airways

BOAC and BEA

Two expert ways to bird watch better:
Swift's Audubon and Triton.

If bird watching is more than a hobby for you, look into these superb binoculars. Both were designed and perfected in cooperation with a team of world famous ornithologists.

The Audubon MKII has an extremely wide field of 445 feet, the extra power of 8.5X, a relative light efficiency of 44.2 and exit pupil of 5.18mm. This provides clear, sharp vision even in deep shadow. For more general nature study, try the Triton MK1 7X35 Prism Binocular.

There's nothing swift about the way we make our products. All our instruments are expertly crafted and painstakingly inspected. We take no short cuts, we don't believe in novelties, and if one of our products has to be serviced, we have representatives the world over.

For the name of your dealer and a copy of our new brochure, write:

SWIFT®
Swift Instruments, Inc., 952 Dorchester Ave., Boston, Mass. 02125

Why don't birds stay where they are while you change lenses?

Because they're birds and they're free! So you have to change your photo habits. One ingenious solution is a zoom lens. It gives you a fast change of focal lengths without moving the camera from your eye.

The Vivitar Automatic Zoom lens goes from 85 to 205mm, opens up to an impressive f3.8 and isn't any larger than most standard 200mm lenses. The highly sophisticated optical design has 13 elements in 9 groups. The Vivitar Automatic Zoom will fit the automatic mounts of the Nikon F, Pentax, Nikkomat, Mamiya/Sekor, Minolta and Canon cameras.

See a demo at your photo dealer or write for test reports by leading photo magazines.

Vivitar Zoom lenses
Marketed in the U.S.A. by
Ponder&Best, Inc.,
1630 Stewart Street,
Santa Monica, California 90406.
In Canada: Precision
Cameras of Canada, Ltd.

one to twenty-five parts per million of TCDD, an extremely toxic impurity belonging to the chemical group called dioxins. As little as ten parts per billion of this compound is capable of causing malformations of developing embryos *in utero*, and the report estimates that between 220 and 360 pounds of TCDD were released into the air over South Vietnam. TCDD appears to be a persistent substance: fish obtained from inland waters in 1973, several years after cessation of the spraying, were found by Meselson and his Harvard colleague chemist Robert Baughman to contain significant quantities of this toxic impurity. This raises the possibility that inadvertent but widespread poisoning of the population may have taken place and may be continuing.

Attempts to substantiate evidence of damage to humans was inconclusive. The report said, "The Committee could find no conclusive evidence of association between exposure to herbicides and birth defects in humans. . . ." The study continued, however, "The Committee has not yet completed its comparison of herbicide-spray records with the dates and places of birth of children with birth defects who were treated at the Barsky Unit, Cho-Ray Hospital, Saigon-Cholon. The Barsky data are probably the best ones that can be obtained in SVN [South Vietnam] for the study of the problem."

It is unlikely that this report will end the controversy that has surrounded the military use of herbicides from the very inception of the program. But partly because of the negative tone of sections of the report, some of the original military supporters of defoliation are now said to have backed off and to have dropped their opposition to including herbicides in the list of weapons proscribed by the Geneva Protocol of 1925. If that is true, then the United States may, at long last, ratify the treaty, which was written largely by Americans but shunned by our country since the post World War I wave of isolationism. There is even some sentiment in Congress for appropriating money to begin to undo the ecological damage we have caused in Vietnam.

Columnist Arthur W. Galston teaches biology at Yale University.

Australia is a land apart. Good thing, too. Or we wouldn't have Kookaburras, Kangaroos, Koalas, and a whole lot of other things you can only find Down Under.

Go to Melbourne's Royal Botanical Gardens, they're the finest in Australia. Visit the Sir Colin Mackenzie Sanctuary where the Platypus was first bred in captivity (that's that funny, furry, duck-billed creature that's actually a living fossil).

On Phillip Island see thousands of Fairy Penguins, the world's smallest. Be a guest at a hundred-year-old homestead. The owners are noted bird-watchers and they'll give you the drum* on our feathered mates. Laughing Kookaburras. Gallahs that flit about like tiny Charlie Chaplins (we Aussies call bad drivers "mug gallahs"). Willy Wagtails. Butcher-birds. Masked Owls. And outlandish kinds of parrots.

In Canberra go to the Tidbinbilla Nature Reserve. All sorts of Kangaroos, lots of them carrying their joeys*. Not to mention Swamp Wallabies, Ring-tailed Possums, Emus (those big silly birds that can't fly a lick), shy bush animals.

In Sydney take a ferry to the Taronga Zoo Park and Aquarium. Inside, fantastic water and wildlife. Outside a bonzer* harbor view, with Sydney's hundred-million-dollar Opera House looking like a mammoth space-age sailboat.

See the Koala Sanctuary in Brisbane. 150 cute slow-pokey Koalas, and cuddling is encouraged. And while you're there visit jungly Lamington National Park. Over 500 waterfalls, orchids thick as weeds, Lyrebirds (if you're lucky you can catch one in a courtship dance).

Naturally, you won't just be taking in our flora and fauna; you'll be enjoying our fine tucker*, and having a good drop* with us Aussies. We're a rare species, too. Don't know how to be unfriendly, so very quickly you become our mates. It'll be a beaut trip.

Just mail in the coupon and we'll tell you more about our reasonably-priced prepackaged wildlife tours. Of course, if you prefer an individual tour, your Travel Agent will gladly plan one for you.

*__The Drum__/the truth *__Joey__/baby kangaroo *__Bonzer__/great *__Tucker__/food *__Good Drop__/drink

Australian Tourist Commission Dept. N2
1270 Avenue of the Americas, N.Y., N.Y. 10020
3550 Wilshire Blvd., Los Angeles, Calif. 90010

Already I'm wild for Australia's wildlife.
Please send me literature on
☐ Birds ☐ Flora ☐ Fauna
I'm interested in ☐ Group Tours
☐ Individual Itineraries

Name

Address

City State Zip

AUSTRALIA Where the good old days are now.

Darwin's Dilemma

The father of evolution anticipated, but failed to prevent, the misunderstanding that has haunted his theory for a century

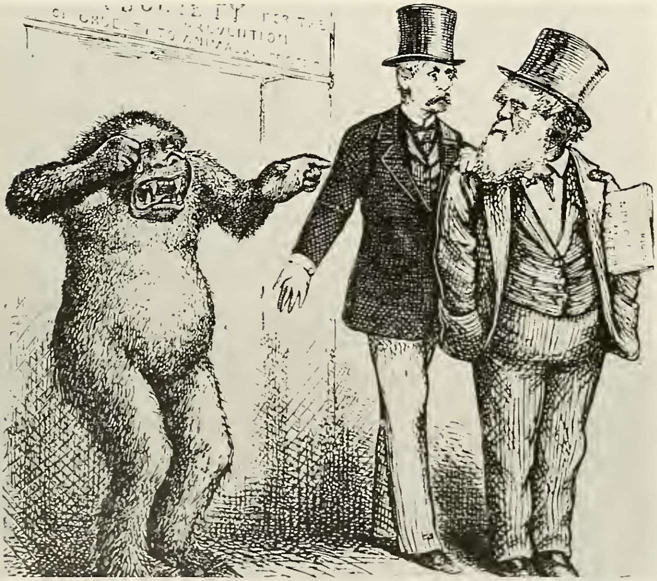
Several readers have requested an explanation for the somewhat cryptic title of my column—"This View of Life." It is taken from the last sentence of Charles Darwin's *Origin of Species:*

> There is grandeur in this view of life, with its several powers, having been originally breathed by the Creator into a few forms or into one; and that, whilst this planet has gone cycling on according to the fixed law of gravity, from so simple a beginning endless forms most beautiful and most wonderful have been, and are being evolved.

This view of life, then, is the evolutionary perspective, the framework, for all my contributions to this column. As a personal statement, it also honors my heroes among past and present evolutionists—Charles Darwin, who coined the phrase, and George Gaylord Simpson, who used it as the title for a collection of essays.

The exegesis of evolution as a concept has occupied the lifetimes of a thousand scientists. Here, I shall present something almost laughably narrow in comparison—an exegesis of the word itself. I shall trace how "this view of life" came to be called *evolution*. The tale is complex and fascinating as a purely antiquarian exercise in etymological detection. But more is at stake, for a past usage of this word has contributed to the most common, current misunderstanding between laymen and scientists.

THE BETTMANN ARCHIVE



In an 1871 cartoon, a gorilla complains, "That man . . . says he is one of my Descendants." The founder of the Society for the Prevention of Cruelty to Animals, Henry Bergh, adds: "Mr. Darwin, how could you insult him so?"

To begin with a paradox: Darwin, Lamarck, and Haeckel—the greatest nineteenth-century evolutionists of England, France, and Germany, respectively—did not use evolution in the original editions of their great works. Why not? And how did their story of organic change acquire its present name?

Darwin, who spoke of "descent with modification," shunned evolution as a description of his theory for two reasons. In Darwin's day, evolution already described a theory of embryology that could not be reconciled with his views of organic development.

In 1744, the German biologist Albrecht von Haller had coined the term *evolution* to describe the notion that embryos grew from preformed homunculi enclosed in the egg or sperm (and that, fantastic as it may seem today, all future generations had been created in the ovaries of Eve or testes of Adam, enclosed like Russian dolls, one within the next—a homunculus in each of Eve's ova, a tinier homunculus in each ovum of the homunculus, and so on). Haller chose his term carefully, for the Latin *evolvere* means "to unroll"; indeed, the tiny homunculus unfolded from its

Do 18th century things
have a place
n our century?

Both antiques and reproductions are the concern of *Early American Life*, our official magazine. Travel, rt, craft, and the telling of the story of the people f young America are our concern too.

Natural History Magazine

LIVING HISTORY

Early American Society

Please enroll me as a member of the Early American Society and bill my annual dues of $6.00 after I have received my first issue of EARLY AMERICAN LIFE. I understand that if the first issue does not live up to my expectations I may cancel without further obligation.

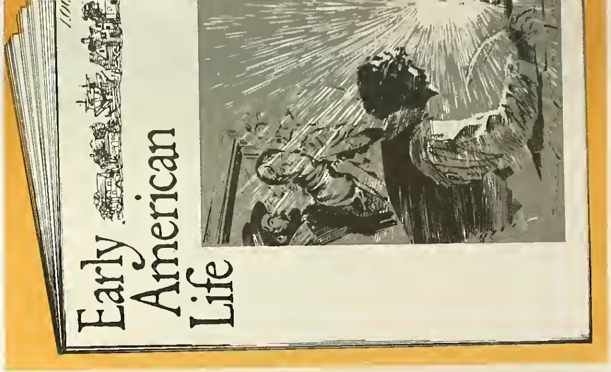
Name ______________________________________

Address ____________________________________

City _______________________________________

State ____________________ Zip __________

6321



BUSINESS REPLY MAIL
No Postage Stamp Necessary if Mailed
in the United States

POSTAGE WILL BE PAID BY

Membership Director
Early American Society
206 Hanover Street,
Gettysburg, Pennsylvania 17325

FIRST CLASS
PERMIT
NO. 237
GETTYSBURG,
PA.

Do 18th century things have a place in our century?

From the 18th and 19th centuries come the warm and beautiful designs in furnishings, tools and accessories that are working a new revolution in the quality of life of twentieth century man. Read here how the Early American Society can help you bring the beauty of early America into your family's life.

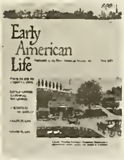
The Early American Society Story

Millions of present-day Americans are stimulated by the warmth and beauty of young America. Some wish to re-create in their homes a total atmosphere that recalls Colonial days. Others practice the skills that created the objects and art of the period. Still others wish to absorb the background - the "social history" of the people of that day through understanding how they lived, loved, and worked.

The Early American Society, founded in 1969, is dedicated to bringing the total story of American social history of the period, 1700-1850, to those who wish to use it in their lives. We accomplish this through several programs including publishing EARLY AMERICAN LIFE six times each year. Our magazine features articles, lavishly illustrated, on arts, crafts, antiques, restoration, travel to historic sites, and all related subjects of interest to members.

To foster reading of books on these subjects, the Early American Society Book Program offers the latest books of leading publishers at discounts up to 25%. Heirloom quality reproductions of outstanding early furniture items are commissioned by the Society and made available only to members in limited editions. Group travel and historical assemblies offer members the opportunity to enrich themselves under the guidance of qualified professionals.

If your special early American interest includes antiques, restoration, arts, crafts, social history, or simply the warm style of the period, 1700-1850, your membership in the Early American Society may become one of your most valuable possessions. We are certain enough of this to offer a no-risk membership. Just mail the application below or the accompanying card. You pay only after your mind is made up that you are satisfied with your membership. Annual dues are $6.00.



Member Service Center · The Early American Society
3300 Walnut St., Boulder, Colo. 80302

Please enroll me as a member in the Early American Society and bill my annual dues of $6.00 after I have received my first issue of EARLY AMERICAN LIFE. I understand that if the first issue does not live up to my expectations I may cancel without further obligation.

Name______________________________

Address______________________________

City______________ State________ Zip________

7067

originally cramped quarters and simply increased in size during its embryonic development.

Yet Haller's embryological evolution seemed to preclude Darwin's descent with modification. If the entire history of the human race was prepackaged into Eve's ovaries, how could natural selection (or any other force) alter the preordained course of our sojourn on earth?

Our mystery seems only to deepen. How could Haller's term be transformed into a nearly opposite meaning? This became possible only because Haller's theory was in its death throes by 1859; with its demise, the term that Haller had used became available for other purposes.

Evolution, in Darwin's day, had become a common English word with a meaning quite different from Haller's technical sense. The *Oxford English Dictionary* traces it to a 1647 poem of H. More: "Evolution of outward forms spread in the world's vast spright [spirit]." But this was "unrolling" in a sense very different from Haller's. It implied "the appearance in orderly succession of a long train of events," and more important, it embodied a *concept of progressive development*—an orderly unfolding from simple to complex. The *O.E.D.* continues, "The process of developing from a rudimentary to a mature or complete state." Thus evolution, in the vernacular, was firmly tied to a concept of progress.

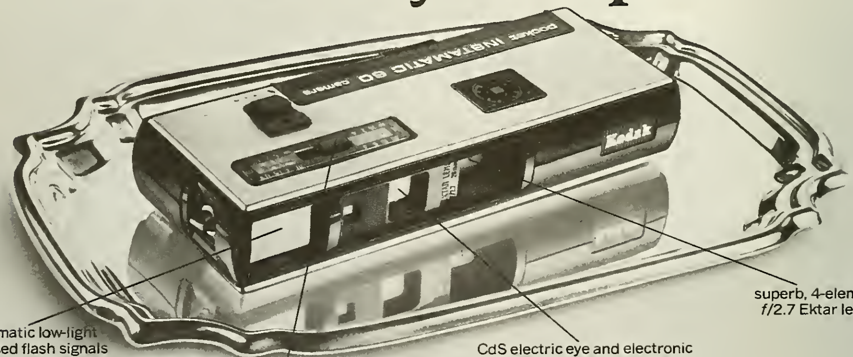
Darwin did use evolve in this vernacular sense—in fact it is the very last word of his book. He chose it for this passage because he wanted to contrast the flux of organic development with the fixity of such physical laws as gravitation. But it was a word he used very rarely indeed, for Darwin explicitly rejected the common equation of what we now call evolution with any notion of progress.

In a famous epigram, Darwin reminded himself never to say "higher" or "lower" in describing the structure of organisms—for if an amoeba is as well adapted to its environment as we are to ours, who is to say that we are higher creatures? Thus Darwin shunned evolution as a description for his descent with modification, both because its technical meaning contrasted with his position and because he was uncomfortable with the notion of inevitable progress inherent in its vernacular meaning.

The propaganda of the indefatigable Herbert Spencer, Victorian pundit of nearly everything, brought evolution into the English language as a synonym for descent with modification. Evolution, to Spencer, was the overarching law of all development. And, to a smug Victorian, what principle other than progress could rule the developmental processes of the universe? Thus, Spencer defined the universal law in his *First Principles* of 1862: "Evolution is an integration of matter and concomitant dissipation of motion; during which the matter passes from an indefinite, incoherent homogeneity to a definite coherent heterogeneity."

Two other aspects of Spencer's work contributed to the establishment of evolution in its present meaning: First, in writing his very popular *Principles of Biology* (1864–1867), Spencer constantly used "evolution" as a description of organic change. Second, he did not view progress as an intrinsic capac-

Our Luxury Compact.



automatic low-light and used flash signals right in viewfinder.

precision-coupled rangefinder for sharp focusing.

CdS electric eye and electronic shutter for highly accurate automatic exposure control.

superb, 4-element *f*/2.7 Ektar lens.

The Pocket of Pockets can be yours for less than $138. It's a sophisticated little camera, but you get all the simple conveniences, too. Like drop-in loading. And, of course, you get big, beautiful pictures. Other models, from less than $23.

Prices are subject to change without notice.

Kodak

Kodak pocket Instamatic® 60 camera.

Ever notice how problems seem to go away when you do?

Out of sight, out of mind.

The most unforgettable vacation you could possibly take these days is one that lets you forget the problems and worries of everyday life.

And every day, we can take you on one of those unforgettable vacations.

To Hawaii, the Orient, and the South Pacific.

And 22 cities in Europe.

And some of the most popular islands in the Caribbean.

Not to mention Latin America.

(Not to mention Latin America, by the way, would be an incredible oversight. Since there're few places in the world where the United States dollar goes further.)

For a flight or a tour to any of those places, call your travel agent. And get some expert help planning and arranging and setting up your Pan Am vacation.

That way, some problems can go away even before you do.

PAN AM

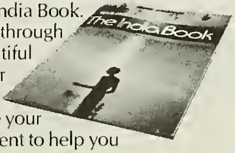
The world's most experienced airline.

Our free book of tours to India will free you from another ordinary trip to another ordinary place.

The India Book is a gift to you from Air-India. It's filled with extraordinary tours of an extraordinary land.

The tours in The India Book are as different as India is. Whatever the duration of your stay, price range or special interest, there's a special tour for you in The India Book.

You can be there this year. Send for The India Book. Wander through the beautiful full-color photos. Then see your travel agent to help you with your arrangements.



AIR-INDIA
666 Fifth Ave., N.Y., N.Y. 10019
Yes! I'd love a
free copy of The India Book.

Name
Address
City
State, Zip NH-6

We work all day to make your night with us a dream.

ity of matter, but as a result of "co-operation" between internal and external (environmental) forces. This view fit nicely with most nineteenth-century concepts of organic evolution, for Victorian scientists easily equated organic change with organic progress. Thus evolution was available when many scientists felt a need for a term more succinct than Darwin's descent with modification. And since most evolutionists saw organic change as a process directed toward increasing complexity (that is, to us), their appropriation of Spencer's general term did no violence to his definition.

Ironically, Darwin, with his aversion to saying "higher" or "lower," stood almost alone in insisting that organic change led only to increasing adaptation between organisms and their own environment and not to an abstract ideal of progress defined by structural complexity. Had we heeded Darwin's warning, we would have been spared much of the confusion and misunderstanding that exists between scientists and laymen today. Scientists long ago abandoned the concept of necessary links between evolution and progress as the worst kind of anthropocentric bias. Yet most laymen still equate evolution with progress and define human evolution not simply as change, but as increasing intelligence, increasing height, or some other measure of assumed improvement.

In what may well be the most widespread antievolutionary document of modern times, the Jehovah's Witnesses' pamphlet "Did Man Get Here by Evolution or by Creation" proclaims: "Evolution, in very simple terms, means that life progressed from one-celled organisms to its highest state, the human being, by means of a series of biological changes taking place over millions of years. . . . Mere change within a basic type of living thing is not to be regarded as evolution."

This fallacious equation of organic evolution with a man-centered concept of progress continues to have unfortunate consequences. Historically, it engendered the abuses of Social Darwinism (which Darwin himself held in such suspicion). This discredited theory ranked human groups and cultures according to assumed level of evolutionary attainment, with (not surprisingly) "advanced" white Europeans at the top and "primitive" people dwelling in their conquered colonies at the bottom.

Today, it remains a primary component of our global arrogance, our belief in dominion over, rather than fellowship with, more than a million other species that inhabit our planet. The moving finger has written, of course, and nothing can be done; yet I am rather sorry that scientists contributed to a fundamental misunderstanding by selecting a vernacular word meaning progress as a name for "this view of life."

Columnist Stephen Jay Gould teaches geology at Harvard University.

WHEN YOU WRITE TO NATURAL HISTORY MAGAZINE

Cut your old address label from magazine
wrapper and attach over this area.
Fill in your NEW address below and mail to:
Natural History Magazine
Membership Services Box 6000
Des Moines, Iowa 50306

H001

☐ 1 year—$8 ☐ 2 years—$15 ☐ 3 years—$21
(Add $2 per year to Canada and other non-U.S. orders)

PLEASE PRINT

Name
New Address
City State Zip

about a change of address, renewal of subscription, billing, or any kind of adjustment, send the present address label from the magazine wrapper.

Moving? Please notify 6 weeks in advance.
You can use this form to tell us about a move or order a subscription.

Change of address—attach your address label in the dotted area and fill in your new address at left, clip and mail to: Natural History Magazine. Membership Services, Box 6000, Des Moines, Iowa 50306.

A new subscription—Check box and fill in name and address at left.

Oddly enough, in strange, elusive India you may come to know yourself better.

When you visit our land, don't rush about. Take it slowly. Let India *happen* to you.

The smallest area is thick with marvels. Start with Delhi and Agra and you've a feast in store for you (take our famous air-conditioned train, the Taj Express; you'll love it).

But you could pick any point on our map. Kerala has palm-swept beaches. In Darjeeling you can see the sunrise over Mt. Everest. Bangalore's all flowers. Assam teems with some of India's rarest wildlife (be adventurous, take an elephant trek).

You can stay at luxury hotels or modestly-priced ones. In modern motels. In palaces. On houseboats. Wherever you are you'll feel very comfortable; we're friendly, and we speak English.

If you like, we'll gladly give you a firsthand glimpse of our way of life—share our meals, our gossip, recommend our guru, our family astrologer, our tailor, the bazaar we go to for our most beautiful gifts (by the way, India is still bargain country).

Try to absorb something of our culture. It's so old, so different, so rich in spirit, it has to affect you. If you find you're getting to know yourself better, don't be surprised. For so many, India is a voyage of self-discovery, too.

For more information for your trip to India please see your Travel Agent or send in the coupon below.

Government of India Tourist Office, N.Y., 19 E. 49th St.; Chicago, 201 No. Michigan Ave.; San Francisco, 685 Market St. Also Canada.

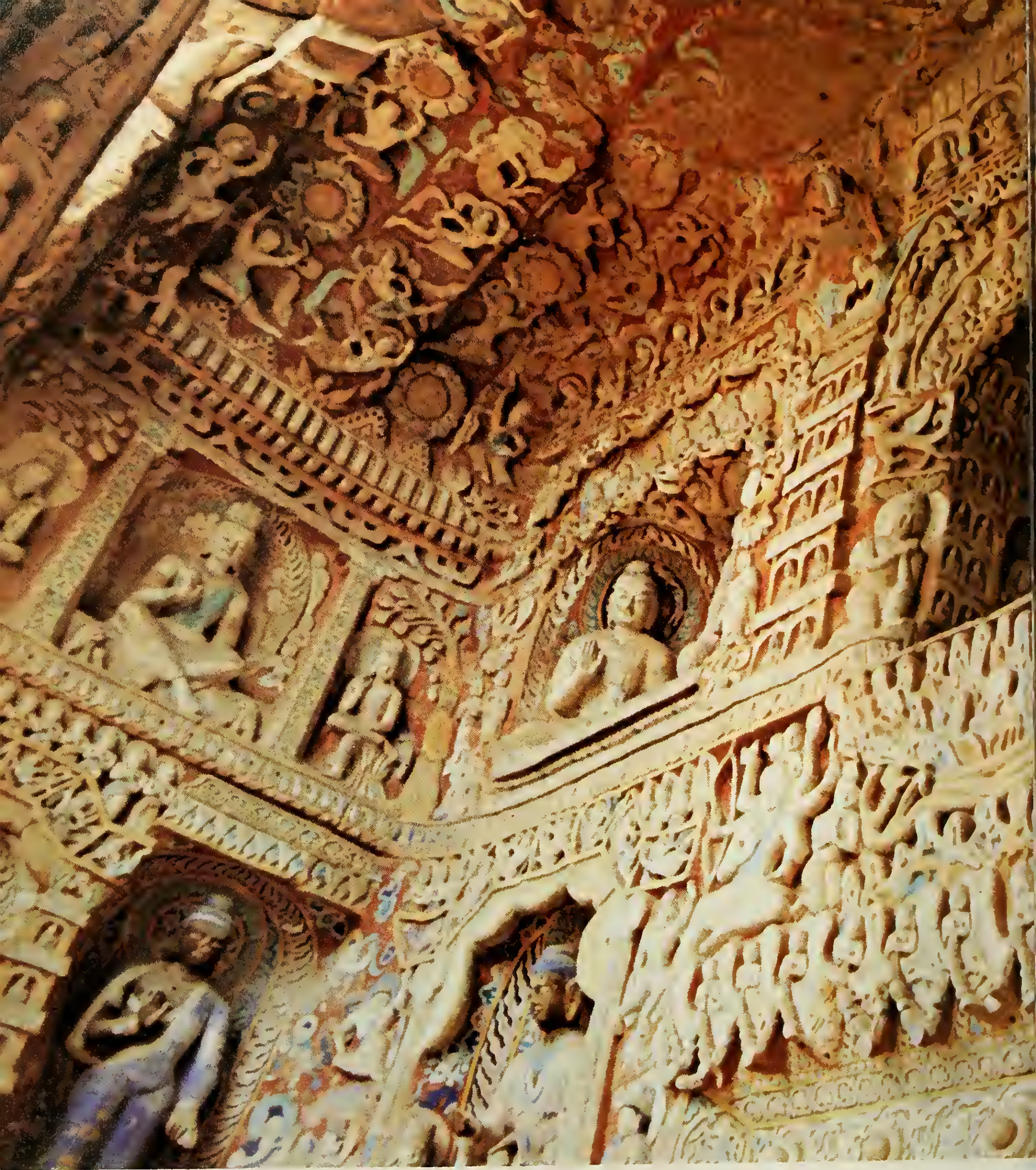
Name____________________

Street____________________

City________State______Zip______

My Travel Agent________________

India.
It's not just another country.
It's another world.



Caves

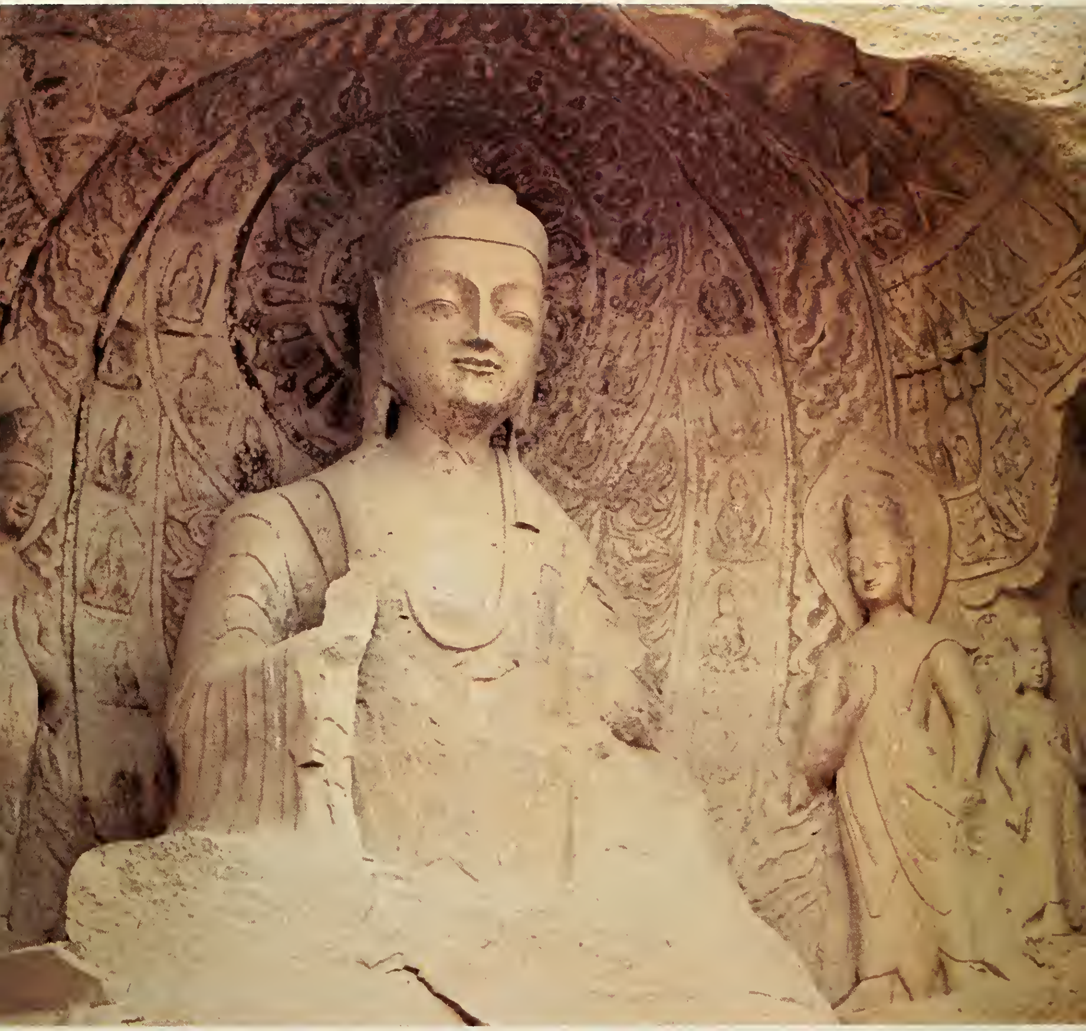
photographs by Bruno Barbey

MAGNUM PHOTOS, INC

# of the Infinite Buddhas

by Judith M. Treistman

Carved into the sandstone cliffs of Shansi Province, the Yün-kang shrines have borne witness to 1,500 years of Chinese history



Li Tao-yuan, a sixth-century geographer-historian, describing the Buddhist cave shrines of Yün-kang, wrote: "Along the ridge the stones are carved and the hills hollowed out. The statues are colossal: rarely has anything similar been seen in the world of men. There are shrines on the hills and pavilions by the water. In the distance, incense-shrouded temples are dimly seen. The groves of trees are like brocade and the lakes like mirrors."

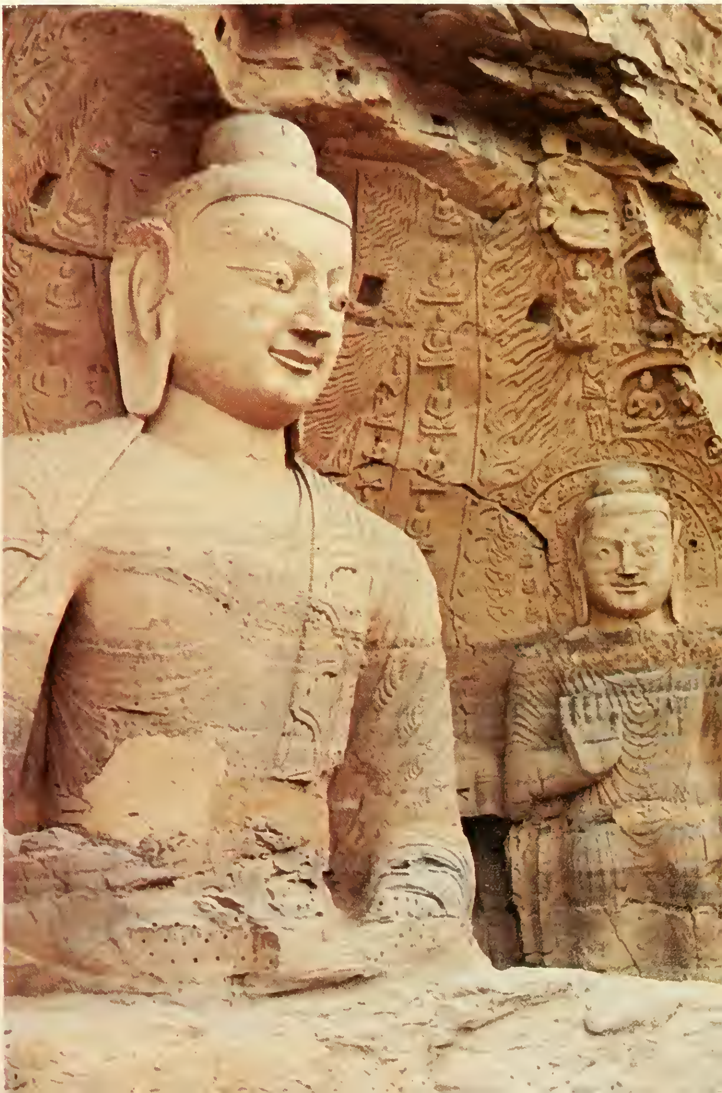
The caves, seemingly randomly spaced, small niches and large, dark grottos, dot the sandstone cliffs for nearly a mile. The head of a huge stone Buddha, largely hidden in the shadows of a cavernous hall, looks out over the barren and dusty plain. Another Buddha, too large to comprehend when viewed from close up, sits on a lotus throne. The walls of the cliff, with thousands of figures carved in relief, look like a tapestry; it is said there are more than 50,000 images at Yün-kang.

During the fifteen centuries since their creation, these caves in Shansi Province have been visited by emperors and merchants, peasants and pastoralists. They have borne witness to persecutions and revolutions. The temples have been abandoned, rebuilt, and abandoned again. Some of the statues have been desecrated and restored. Donors and worshipers have come to the caves, but so too have thieves, who hacked the carved

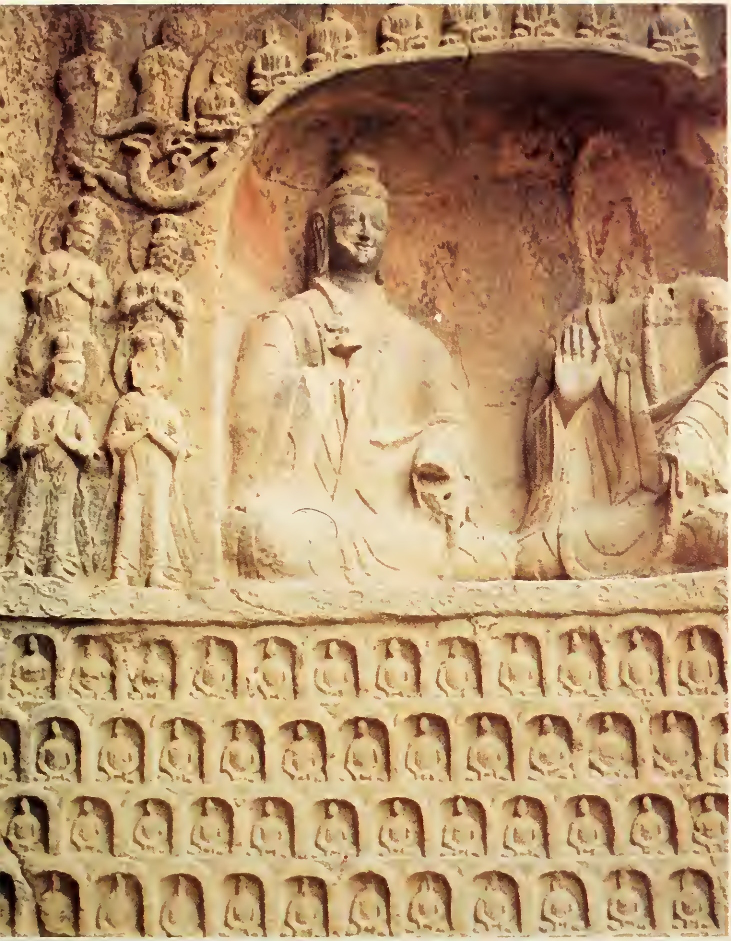
stone out of the mountain and sold the statues to foreigners. In sum, the Buddhas, bodhisattvas, and multitudes of human and celestial beings have witnessed 1,500 years of Chinese history.

In 1961 the caves were declared a national monument, to be preserved and maintained as a valued relic of antiquity. Throughout the long existence of Yün-kang the role of "monument" has been uppermost; even at its creation it was as much a political as a religious expression. In contemporary times, the art has been viewed through the filters of Buddhist worship, Western esthetics, and ethnic history, but within the People's Republic of China interest has returned to the original (although perhaps only implicit) intent, which emphasizes, not the content of the monument, but its existence as a symbol of the identity of the national past and the ideal of political unification.

Yün-kang is located in present-day Ta-t'ung district, about 10



The main caves at Yün-kang, carved during a period of forty years, show increasing Chinese influence. Earlier Buddhas, right, ca. 460, are robust and expressive in the Western manner, but those carved in 490, above, reflect the flat, linear style of Chinese painting.



Buddhist symbols are evident throughout Yün-kang. The raised right hands of the twin Buddhas, left, signify reassurance; beneath them, replication of the "thousand Buddhas" emphasizes the belief that anyone can attain Buddhahood. Below: Three Buddhas and a bodhisattva (lower left) are carved into four niches that symbolize the four quarters of the universe.

miles from the city of Ta-t'ung and 250 miles northwest of Peking. It is in the semiarid loessland region of northern China, the region of the Great Wall, of centuries of interchange between agriculturalists and pastoral nomads.

During the Han dynasty's reign in the north-central China plain, at the beginning of the third century, Ta-t'ung was an important commercial and administrative center. Later, when regionalism prevailed (called the Period of Disunity, A.D. 315–585) the city was the earliest capital of the Northern Wei dynasty. The emperor's palace (remains of its pillars and tiles were recently excavated) was located there. The palace had a number of gates, their stupas or pagodas "reaching to the sky." A broad avenue led to the palace's central gate; streams on each side of the avenue encircled the palace buildings. On the banks of the eastern stream were great Buddhist temples—a five-storied drum tower and a seven-storied stupa. A Taoist temple also stood to the east, while a smaller three-storied stupa was on the western bank. Gardens in the western and southern sectors of the city included special medicinal plants. In the northern garden there were reflecting ponds and an enclosure for tigers; Buddhist monks meditated near a stupa temple and in meditation caves. There was a military encampment and training ground outside the eastern sector. Cypress groves, a great royal mausoleum with elaborately decorated pillars, and screens of carved bluestone dotted the countryside. In the distance were the sacred places: Yün-kang and Mount Wu Tai. The city flourished until 494, when a new capital was established at Loyang.

The well-planned city of Ta-t'ung, which had endured as the capital for only a hundred years, reflected the contradiction between the power that resided in the military framework of the conquering northern pastoralists and the agriculturally based power of the Han Chinese political organization. Both in layout and administration, the city of Ta-t'ung fostered the Chinese image of the cosmic order, highly bureaucratized and bounded, civil as opposed to barbaric. But underlying this image was the "barbarian" vision of limitless expansion captured in the Yün-kang caves.

The Northern Wei dynasty, which established Ta-t'ung as its capital, had been founded by a dominant clan, or family, of the T'o-pa people. T'o-pa is used collectively to represent all the tribes or tribal remnants incorporated into the military state that grew out of hundreds of years of nomadic raiding on sedentary agriculturalists and competition for grassland resources. The T'o-pa probably originated in the frontier territories of Mongolia and Manchuria, absorbing other tribes and rapidly assimilating migrating peasants and artisans of Han Chinese origin.

In the process of conquering northern China, the T'o-pa underwent a series of structural changes that prepared them to assume statehood and eventually take control of an empire. These changes grew out of their need to gain access to the agricultural wealth of the north China plains. The T'o-pa used the local Chinese gentry of the conquered eastern territories to extract produce and taxes from the peasants and established a supportive network of military outposts running from the hinterlands to the capital, where Chinese literati and nobility had been drawn into court service. The T'o-pa rulers had destroyed their own tribal foundations by substituting a military organization for clanship; they now brought tribal chieftains to the court as military officers and converted other pastoralist tribes into military units.

In 462, class stratification was codified. A number of edicts, which crosscut ethnic boundaries, regulated dress style, language, and courtly behavior, and forbade intermarriage between the classes. The classes were legally defined as gentry, commoners, private and state serfs, and slaves. There were also numerous service categories, such as "tomb families," who maintained the royal graves, postal families, kiln families, musicians, magicians, and medical specialists.

The edicts also created an aristocracy of the eight leading T'o-pa families and four great Chinese families. The need to bring more and more Chinese officials into administrative positions raised new problems for the T'o-pa. Because of the extended kinship system of the Chinese, each official was part of a ramifying network of people to whom wealth was now accessible. T'o-pa wealth, on the other hand, formerly derived from their herds, was now much deteriorated. To remain a state power in the face of growing Chinese power from within, the T'o-pa had to make the transition from a pastoral economy to one based on land and agriculture.

As a method of opening up new land and reclaiming abandoned tracts (it is estimated that about 20 percent of the Chinese peasant population migrated south during this period), the T'o-pa in 486 instituted the "equal fields" system of land distribution. Under this system, the state allocated lots to each adult man. The land always reverted to the state, and except for plots on which mulberry trees were cultivated, proprietorship could never pass from father to son. In return, each farmer paid a grain tax and a cloth tax and gave twenty days of service to the state. In addition to raising revenues, increasing production, and restraining the growth of the great Chinese land-owning families, this system had another effect: by assuming that all land belonged to the state, it legitimized the concept of sovereignty.

The T'o-pa were struggling to maintain their identity. Not only were they faced with an increasing movement toward Sinicization but they were also undergoing radical social change. They found a partial solution by embracing Buddhism. The motivation was complex; cer-

tainly the historical experience in Central Asia and India had demonstrated the intimate ties of institutional Buddhism and commercial development. The monasteries and temples were also the inns and hostels, and eventually the banks, for merchants traveling the Great Silk Road. Earlier patterns of trade and tributary exchange had defined social and political relationships between the Han Chinese and the various nomadic tribes and had provided a primary channel for population movement on the frontier. Buddhism, especially in the form it took in this area, gave intellectual support to these relationships. While the rigid, hierarchical political philosophy of Confucianism had no room for barbarians and merchants, the Buddhist vision facilitated social change.

At the same time, the T'o-pa rulers used Buddhism as they used the equal fields system—to legitimize sovereignty and maintain their integrity in the face of the Chinese gentry upon whom they relied increasingly for much of their support. The T'o-pa emperor soon came to be regarded as a Buddha and established a state religion. The peasants, Chinese and barbarian, as well as the wandering herders, were able to find elements of their own folk religions in Buddhist practice, while the message of salvation appealed to them in a time of ferment and growing impoverishment.

The early Northern Wei emperors built temples and monasteries, encouraged monks to gather and discuss religious doctrine, and established an academy for the study and translation of Buddhist documents. The monasteries and temples prospered, the rich made endowments of land to escape taxation, and the poor flocked to the Buddhist centers to escape military and *corvée* service.

Passageways, balconies, and arches give the caves a feeling of expansion and suggest the limitlessness of Buddhism. The blue paint is a product of restoration.

In time, however, Buddhist expansion proved so successful that it threatened the secular government. The Northern Wei, suffering from the drain of manpower, grain fields, and tax money, began to persecute the Buddhists, destroying temples and icons, murdering many monks and nuns, and prohibiting anyone under the age of fifty from joining monastic orders. The persecution lasted from 446 to 450, and during this time the Confucian ethos of the Han Chinese gained dominance.

The Northern Wei were caught. In an effort to suppress the Han Chinese, unify northern China, and forge a new cultural identity, they now attempted to reestablish Buddhist supremacy. The middle years of Ta-t'ung's history were called *Ho-ping*, "the time of peace and harmony." During these years of constructive reflection the conflict was raised to a conscious level and Yün-kang was built.

In 466 the emperor appointed a monk to take charge of all Buddhist affairs. This monk, T'an-yao, proposed to the emperor that five excavations be made in the cliffs of the Wu Chou hills and that a huge image of the Buddha "ornamented more beautifully than any to be seen in the world" be carved in each hollow. According to later Chinese commentaries, these plans were designed to protect the shrines: the mountain cliffs were sheltered; the statues were carved of indestructible stone, rather than made of clay as in earlier times and other regions; their colossal size would prevent desecration; and the images were "multiplied into infinity" in order to withstand anticipated attacks. In fact, all these features have symbolic reference to folk religious beliefs, as well as to Buddhist philosophy.

The largest of the caves could accommodate three thousand people. At the eastern end of the ridge, T'an-yao built a monastery for one thousand monks. Excavation and building continued on a grand scale until the Northern Wei moved to Lo-yang at the end of the fifth century. For the next 600 years Ta-t'ung was simply an abandoned city and Yün-kang was left in the hands of a few pious monks.

In the eleventh century, however, Ta-t'ung became one of the five capitals of the Liao dynasty, and during the ensuing Buddhist revival, the Yün-kang caves were restored; there is a Liao inscription recording repairs made to 1,876 figures. New sculptures were dedicated and small temples constructed outside the caves. Then, they were again abandoned, this time for five centuries. Toward the end of the Ming era, when peaceful frontier conditions were secured, commerce and pilgrimages to Yün-kang resumed. Inns were opened and the temples served as hostels for hundreds of travelers. Poems were written to celebrate the visits of famous people, and in 1696, after he had stopped at the caves, the Emperor K'ang-hsi initiated restoration.

Foreigners, especially French archeologists, began to study the caves in the early twentieth century, but definitive explorations and recordings were undertaken by Japanese scholars. Interestingly, this research was carried out both before and during the Sino-Japanese war and continued until 1945. To raise money for the expedition and final publication of the many volumes of photographs, maps, and rubbings, the "Society for Support of Scientific Investigation of the Yün-kang Caves" was formed in Kyoto in 1940.

The caves provide an extraordinarily rich source of data for those interested in the lexicon of Buddhist iconography as well as for the art historian. A Classical figure holding a trident and wearing a winged hat looks across a doorway at a three-headed Siva; Sumerian lions and central Asian griffons, Han-style tigers and dragons, lotus blossoms from India, and the architectural permutations that transformed the Indian stupa into the Chinese pagoda—all these have provided great sport for the scholar juggling time and ideas outside the boundaries of a historical era and outside of a cultural tradition.

Yet the Yün-kang cave shrines were created within a span of about forty years and, although stylistic changes can be perceived and individual differences in craftsmanship are evident, the whole can be viewed as a single monument, with layers of meaning that were apparent to the viewers of the fifth century as well as to the artists. Appreciation of these meanings did not depend upon recognition of the Greek Neptune, for example.

The people of central Asia, southern Manchuria, and Mongolia, unlettered—certainly in Sanskrit and in Buddhist iconography—could nonetheless respond to the concept of the sanctified cave within the rock. The all-pervasive and powerful "emptiness" of the Buddha was inherent in the giant statues: the viewer was forced to walk around the colossal figures yet could never "see" them except in partial view. But the replication of the "thousand Buddhas" in each great cave, on the cliffs, and in the temples reinforced the belief that every individual could attain Buddhahood. The beauty of the celestial musicians needed no convention for ecstatic understanding. The ornamental designs were exotic but not so strange as to be unpleasing.

The question of how the people could accept a foreign art can be answered in the context of what was happening in the monasteries and the marketplace. During the period that the caves were built, major Buddhist works were being translated and copied into Chinese. Also, the exchange of pilgrims between India and China had accelerated, mirroring the increased tempo and volume of trade between East and West. Silks, porcelains, and metalwork, bearing the art motifs of the Western world, were becoming familiar to more and more people.

The instructive aspect of the caves, counterpart of the textual translations, is most apparent in the cave containing the *jatakas*, scenes representing events in Siddhartha Gautama's life. It was the first time they appeared in China. In this cave the central core of rock has been sculptured into the shape of a pagoda resting on four elephants' backs. As one walks around the central pagoda, one can follow a bas-relief running along the sides of the cave just above eye level. It depicts episodes of Gautama's early life: his encounters with poverty and disease, his farewell to his wife, his renunciation of asceticism, and his final escape on the horse with muffled hoofs.

The pagoda itself has four grand Buddhas in various postures of contemplation. The calm and inert mass of the Buddha is in contrast to the carved walls and ceilings, where rays of light play on the features of a compassionate bodhisattva and illuminate the multitude of celestial beings, the niches with small statues, and the ornamental friezes that seem to embrace everything. There is an upward, spiraling movement within the cave, and the density of the carvings gives the stone a lifelike quality.

The cultural tensions between the Han Chinese and the T'o-pa at the court of Ta-t'ung were partly resolved in the art of Yün-kang, as a distinctive style emerged. Conventions of Western Buddhist art were reinterpreted. The simple lotus blossom, symbol of birth and rebirth, became more intricate. The pointed arch, which derived from the lotus motif and which formed the niche in the Indian tradition, became an architectural device at Yün-kang, used to create interior space. The addition of Chinese-style balconies, railings, roofs, and side posts gave the rock a constructed appearance.

The melding of forms accomplished in the decorative art at Yün-kang created a fresh style, expanding beyond Buddhist art per se and becoming part of a genuine folk tradition. Yün-kang set the stage, but the merger of East and West—the animals and birds of central Asia painted into landscapes that derived from the ancient "Po' Shan" censers, Western floral designs transformed into the silhouette style of the traditional Chinese bronze mirrors—would be explored in many media for many generations.

The art at Yün-kang, however, also reflects the economic and political pressures that ultimately forced the Northern Wei to abandon Ta-t'ung and attempt to promulgate their way of life in the Chinese city-center of Lo-yang. The earliest statues were free and expressive, but later ones reveal the increasing Chinese influence and seem curiously restrained, reflecting the flat, linear style of Chinese painting. The radiance of the wild nimbi and celestial scenes was subdued, and the bodhisattvas and secular worshipers no longer wore northern costumes, but were dressed in the Chinese court manner. In the words of the Japanese scholars who studied Ta-t'ung, there was a transformation from "an imagined exotic to a realistic Chinese style."

Thus was the tragedy of the T'o-pa artistically expressed. With their move to Lo-yang, T'o-pa identity was subsumed into that of the Sui. Then the T'ang rose to power, imposing Han-style bureaucracy on wider and wider spheres of Chinese society. It would, however, be false to say simply that the T'o-pa lost their identity and became Sinicized or assimilated, for it was out of confrontations such as that at Ta-t'ung and others with southern "barbarians" that the greatness of these Chinese dynasties was born.

Perhaps this is why the Yün-kang caves can be comfortably incorporated into present-day China's dominant political ideology; as a monument, they are once again expressive of potential national unity and cultural renaissance. Although such a view ignores the religious content of the caves, it does not reject it. The current emphasis on the heritage of the past is an example of an ancient form given new meaning. In the case of Yün-kang, this symbolic interpretation may be surprisingly close to the intentions of the caves' creators. ☐

Ta-t'ung and the Yün-kang caves were abandoned at the end of the fifth century. But 600 years later, the Liao dynasty revived Buddhism in the area and built new temples. The images, right, are of lacquered clay.

When the Turtle Collapses, the World Ends

by Bernard Nietschmann

After delivering a lecture on the solar system, philosopher-psychologist William James was approached by an elderly lady who claimed she had a theory superior to the one described by him.

"We don't live on a ball rotating around the sun," she said. "We live on a crust of earth on the back of a giant turtle."

Not wishing to demolish this absurd argument with the massive scientific evidence at his command, James decided to dissuade his opponent gently.

"If your theory is correct, madam, what does this turtle stand on?"

"You're a very clever man, Mr. James, and that's a good question, but I can answer that. The first turtle stands on the back of a second, far larger, turtle."

"But what does this second turtle stand on?" James asked patiently.

The old lady crowed triumphantly, "It's no use, Mr. James—it's turtles all the way down."

In the half-light of dawn, a sailing canoe approaches a shoal where nets have been set the day before. A Miskito turtleman stands in the bow and points to a distant splash that breaks the gray sheen of the Caribbean waters. Even from a hundred yards, he can tell that a green turtle has been caught in one of the nets. His two companions quickly bring the craft alongside the turtle, and as they pull it from the sea, its glistening shell reflects the first rays of the rising sun. As two men work to remove the heavy reptile from the net, the third keeps the canoe headed into the swells and beside the anchored net. After its fins have been pierced and lashed with bark fiber cord, the 250-pound turtle is placed on its back in the bottom of the canoe. The turtlemen are happy. Perhaps their luck will be good today and their other nets will also yield many turtles.

These green turtles, caught by Miskito Indian turtlemen off the eastern coast of Nicaragua, are destined for distant markets. Their butchered bodies will pass through many hands, local and foreign, eventually ending up in tins, bottles, and freezers far away. Their meat, leather, shell, oil, and calipee, a gelatinous substance that is the base for turtle soup, will be used to produce goods consumed in more affluent parts of the world.

The coastal Miskito Indians are very dependent on green turtles. Their culture has long been adapted to utilizing the once vast populations that inhabited the largest sea turtle feeding grounds in the Western Hemisphere. As the most important link between livelihood, social interaction, and environment, green turtles were the pivotal resource around which traditional Miskito Indian society revolved. These large reptiles also provided the major source of protein for Miskito subsistence. Now this priceless and limited resource has become a prized commodity that is being exploited almost entirely for economic reasons.

In the past, turtles fulfilled the nutritional needs as well as the social responsibilities of Miskito society. Today, however, the Miskito depend mainly on the sale of turtles to provide them with the money they need to purchase household goods and other necessities. But turtles are a declining resource; overdependence on them is leading the Miskito into an ecological blind alley. The cultural control mechanisms that once adapted the Miskito to their environment and faunal resources are now circumvented or inoperative, and they are caught up in a system of continued intensification of turtle fishing, which threatens to provide neither cash nor subsistence.

I have been studying this situation for several years, unraveling its historical context and piecing together its past and future effect on Miskito society, economy, and diet, and on the turtle population.

The coastal Miskito Indians are among the world's most adept small-craft seamen and turtlemen. Their traditional subsistence system provided dependable yields from the judicious scheduling of resource procurement activities. Agriculture, hunting, fishing, and gathering were organized in accordance with

Miskito Indians haul a green turtle from the Caribbean. Overexploitation has caused the decline of these turtles and the human culture they supported.

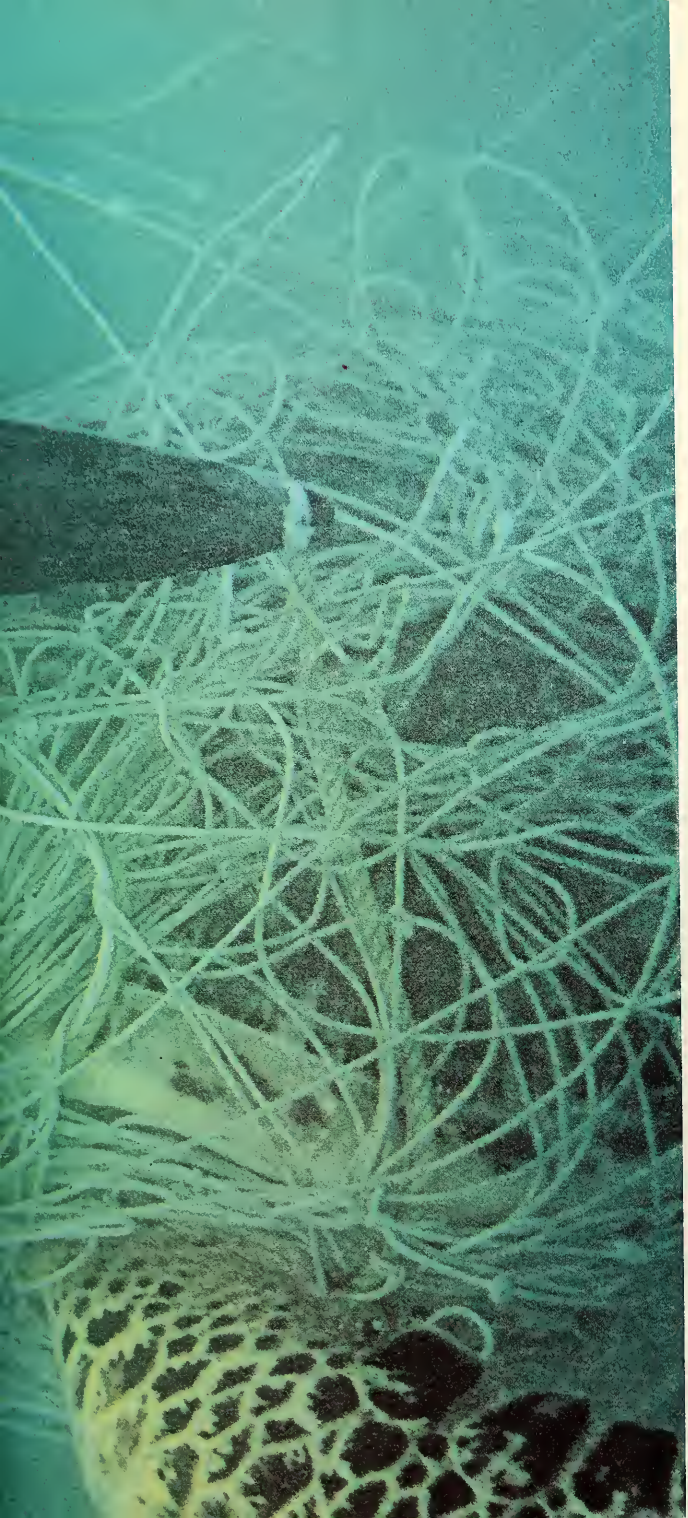
BERNARD NIETSCHMANN

seasonal fluctuations in weather and resource availability and provided adequate amounts of food and materials without overexploiting any one species or site. Women cultivated the crops while men hunted and fished. Turtle fishing was the backbone of subsistence, providing meat throughout the year.

Miskito society and economy were interdependent. There was no economic activity without a social context and every social act had a reciprocal economic aspect. To the Miskito, meat, especially turtle meat, was the most esteemed and valuable resource, for it was not only a mainstay of subsistence, it was the item most commonly distributed to relatives and friends. Meat shared in this way satisfied mutual obligations and responsibilities and smoothed out daily and seasonal differences in the acquisition of animal protein. In this way, those too young, old, sick, or otherwise unable to secure meat received their share, and a certain balance in the village was achieved: minimal food requirements were met, meat surplus was disposed of to others, and social responsibilities were satisfied.

Today, the older Miskito recall that when meat was scarce in the village, a few turtlemen would put out to sea in their dugout canoes for a day's harpooning on the turtle feeding grounds. In the afternoon, the men would return, sailing before the northeast trade wind, bringing meat for all. Gathered on the beach, the villagers helped drag the canoes into thatched storage sheds. After the turtles were butchered and the meat distributed, everyone returned home to the cooking fires.

Historical circumstances and a series of boom–bust economic cycles disrupted the Miskito's society



Surfacing for air, this hawksbill turtle became entangled in a net near the surface. The shell of this rare species will be sold to the jewelry trade.

BERNARD NIETSCHMANN

and environment. In the seventeenth and eighteenth centuries, intermittent trade with English and French buccaneers—based on the exchange of forest and marine resources for metal tools and utensils, rum, and firearms—prompted the Miskito to extend hunting, fishing, and gathering beyond subsistence needs to exploitative enterprises.

During the nineteenth and early twentieth centuries, foreign-owned companies operating in eastern Nicaragua exported rubber, lumber, and gold, and initiated commercial banana production. As alien economic and ecological influences were intensified, contract wage labor replaced seasonal, short-term economic relationships; company commissaries replaced limited trade goods; and large-scale exploitation of natural resources replaced sporadic, selective extraction. During economic boom periods the relationship between resources, subsistence, and environment was drastically altered for the Miskito. Resources became a commodity with a price tag, market exploitation a livelihood, and foreign wages and goods a necessity.

For more than 200 years, relations between the coastal Miskito and the English were based on sea turtles. It was from the Miskito that the English learned the art of turtling, which they then organized into intensive commercial exploitation of Caribbean turtle grounds and nesting beaches. Sea turtles were among the first resources involved in trade relations and foreign commerce in the Caribbean. Zoologist Archie Carr, an authority on sea turtles, has remarked that "more than any other dietary factor, the green turtle supported the opening up of the Caribbean." The once abundant turtle populations provided sustenance to ships' crews and to the new settlers and plantation laborers.

Villagers vie to purchase turtle meat, but there will not be enough for all; foreign processing plants buy between 70 and 90 percent of the catch.

BERNARD NIETSCHMANN

The Cayman Islands, settled by the English, became in the seventeenth and eighteenth centuries the center of commercial turtle fishing in the Caribbean. By the early nineteenth century, pressure on the Cayman turtle grounds and nesting beaches to supply meat to Caribbean and European markets became so great that the turtle population was decimated. The Cayman Islanders were forced to shift to other turtle areas off Cuba, the Gulf of Honduras, and the coast of eastern Nicaragua. They made annual expeditions, lasting four to seven weeks, to the Miskito turtle grounds to net green turtles, occasionally purchasing live ones, dried calipee, and the shells of hawksbill turtles (*Eretmochelys imbricata*) from the Miskito Indians. Reported catches of green turtles by the Cayman turtlers generally ranged between 2,000 and 3,000 a year up to the early 1960s, when the Nicaraguan government failed to renew the islanders' fishing privileges.

Intensive resource extraction by foreign companies led to seriously depleted and altered environments. By the 1940s, many of the economic booms had turned to busts. As the resources ran out and operating costs mounted, companies shut down production and moved to other areas in Central America. Thus, the economic mainstays that had helped provide the Miskito with jobs, currency, markets, and foreign goods were gone. The company supply ships and commissaries disappeared, money became scarce, and store-bought items expensive.

In the backwater of the passing golden boom period, the Miskito were left with an ethic of poverty, but they still had the subsistence skills that had maintained their culture for hundreds of years. Their land and water environment was still capable of providing reliable resources for local consumption. As it had been in the past, turtle fishing became a way of life, a provider of life itself. But traditional subsistence culture could no longer integrate Miskito society and environment in a state of equilibrium. Resources were now viewed as having a value and labor a price tag. All that was needed was a market.

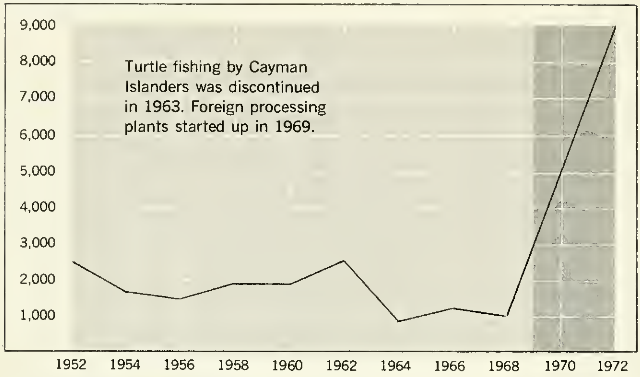
Recently, two foreign turtle companies began operations along the east coast of Nicaragua. One was built in Puerto Cabezas in late 1968, and another was completed in Bluefields in 1969. Both companies were capable of processing and shipping large amounts of green turtle meat and by-products to markets in North America and Europe. Turtles were acquired by purchase from the Miskito. Each week company boats visited coastal Miskito communities and offshore island turtle camps to buy green turtles. The "company" was back, money was again available, and the Miskito were expert in securing the desired commodity. Another economic boom period was at hand. But the significant difference between this boom and previous ones was that the Miskito were now selling a subsistence resource.

As a result, the last large surviving green turtle population in the Caribbean was opened to intensive, almost year-round exploitation. Paradoxically, it would be the Miskito Indians, who once caught only what they needed for food, who would conduct the assault on the remaining turtle population.

Another contradictory element in the Miskito–turtle story is that only some 200 miles to the south at Tortuguero, Costa Rica, Archie Carr had devoted fifteen years to the study of sea turtles and to the conservation and protection of the Caribbean's last major sea turtle nesting beach. Carr estimates that more than half the green turtles that nest at Tortuguero are from Nicaraguan waters. The sad and exasperating paradox is that a conservation program insured the survival of an endangered species for commercial exploitation in nearby waters.

Green turtles, *Chelonia mydas*, are large, air-breathing, herbivorous marine reptiles. They congregate in large populations and graze on underwater beds of vegetation in relatively clear, shallow, tropical waters. A mature turtle can weigh 250 pounds or more and when caught, can live indefinitely in a saltwater enclosure or for a couple of weeks if

NUMBER OF GREEN TURTLES EXPORTED ANNUALLY FROM EASTERN NICARAGUA



kept in shade on land. Green turtles have at least six behavioral characteristics that are important in their exploitation: they occur in large numbers in localized areas; they are air breathing, so they have to surface; they are mass social nesters; they have an acute location-finding ability; when mature, they migrate seasonally on an overlapping two- or three-year cycle for mating and nesting; and they exhibit predictable local distributional patterns.

The extensive shallow shelf off eastern Nicaragua is dotted with numerous small coral islands, thousands of reefs, and vast underwater pastures of marine vegetation called "turtle banks." During the day, a large group of turtles may be found feeding at one of the many turtle banks, while adjacent marine pastures may have only a few turtles. They graze on the vegetation, rising periodically to the surface for air and to float for awhile before diving again. In the late afternoon, groups of turtles will leave the feeding areas and swim to shoals, some up to four or five miles away, to spend the night. By five the next morning, they gather to depart again for the banks. The turtles' precise, commuterlike behavior between sleeping and feeding areas is well known to the Miskito and helps insure good turtling.

Each coastal turtling village exploits an immense sea area, containing many turtle banks and shoals. For example, the Miskito of Tasbapauni utilize a marine area of approximately 600 square miles, with twenty major turtle banks and almost forty important shoals.

Having rather predictable patterns of movement and habitat preference, green turtles are commonly caught by the Miskito in three ways: on the turtle banks with harpoons; along the shoal-to-feeding area route with harpoons; and on the shoals using nets, which entangle the turtles when they surface for air.

The Miskito's traditional means of taking turtles was by harpoon—an eight- to ten-foot shaft fitted with a detachable short point tied to a strong line. The simple technology pitted two turtlemen in a small, seagoing canoe against the elusive turtles. Successful turtling with harpoons requires an extensive knowledge of turtle behavior and habits and tremendous skill and experience in handling a small canoe in what can be very rough seas. Turtlemen work in partnerships: a "strikerman" in the bow; the "captain" in the stern. Together, they make a single unit engaged in the delicate and almost silent pursuit of a wary prey, their movements coordinated by experience and rewarded by proficiency. Turtlemen have mental maps of all the banks and shoals in their area, each one named and located through a complex system of celestial navigation, distance reckoning, wind and current direction, and the individual surface-swell motion over each site. Traditionally, not all Miskito were sufficiently expert in seamanship and turtle lore to become respected "strikermen," capable of securing turtles even during hazardous sea conditions. Theirs was a very specialized calling. Harpooning restrained possible overexploitation since turtles were taken one at a time by two men directly involved in the chase, and there were only a limited number of really proficient "strikermen" in each village.

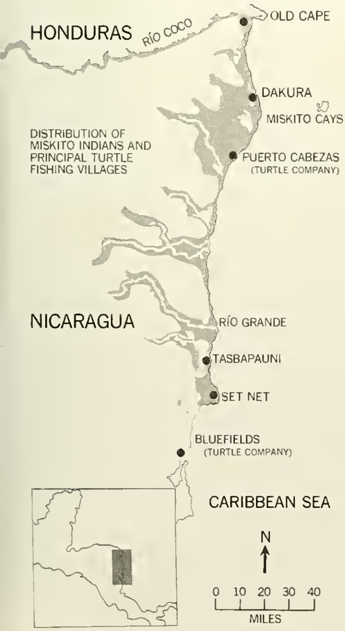
Those who still use harpoons must leave early to take advantage of the land breeze and to have enough time to reach the distant offshore turtle grounds by first light. Turtlemen who are going for the day, or for several days, will meet on the beach by 2:00 A.M. They drag the canoes on bamboo rollers from beachfront sheds to the water's edge. There, in the swash of spent breakers, food, water, paddles, lines, harpoons, and sails are loaded and secured. Using a long pole, the standing bowman propels the canoe through the foaming surf while the captain in the stern keeps the craft running straight with a six-foot mahogany paddle. Once past the inside break, the men count the dark rolling seas building outside until there is a momentary pause in the sets; then with paddles digging deep, they drive the narrow, twenty-foot canoe over the cresting swells, rising precipitously on each wave face and then plunging down the far side as the sea and sky seesaw into view. Once past the breakers, they rig the sail and, running with the land breeze, point the canoe toward a star in the eastern sky.

A course is set by star fix and by backsight on a prominent coconut palm on the mainland horizon. Course alterations are made to correct for the direction and intensity of winds and currents. After two or three hours of sailing the men reach a distant spot located between a turtle sleeping shoal and feeding bank. There they intercept and follow the turtles as they leave for specific banks.

On the banks the turtlemen paddle quietly, listening for the sound of a "blowing" turtle. When a turtle surfaces for air it emits a hissing sound audible for fifty yards or more on a calm day. Since a turtle will stay near the surface for only a minute or two before diving to feed, the men must approach quickly and silently, maneuvering the canoe directly in front of or behind the turtle. These are its blind spots. Once harpooned, a turtle explodes into a frenzy of action, pulling the canoe along at high speeds in its hopeless, underwater dash for escape until it tires and can be pulled alongside the canoe.

But turtle harpooning is a dying art. The dominant method of turtling today is the use of nets. Since their introduction, the widespread use of turtle nets has drastically altered turtling strategy and productivity. Originally brought to the Miskito by the Cayman Islanders, nets are now extensively distributed on credit by the turtle companies. This simple technological change, along with a market demand for turtles, has resulted in intensified pressure on green turtle populations.

Buoyed by wooden floats and anchored to the bottom by a single line, the fifty-foot-long by fourteen-foot-wide nets hang from the surface like underwater flags, shifting direction with the current. Nets are set in place during midday when the turtlemen can see the dark shoal areas. Two Miskito will set five to thirty nets from one canoe, often completely saturating a small shoal. In the late afternoon, green turtles return to their shoals to spend the night. There they will sleep beside or beneath a coral outcrop, periodically surfacing for air where a canopy of nets awaits them.


HONDURAS
RÍO COCO
OLD CAPE
DAKURA
MISKITO CAYS
DISTRIBUTION OF MISKITO INDIANS AND PRINCIPAL TURTLE FISHING VILLAGES
PUERTO CABEZAS (TURTLE COMPANY)
NICARAGUA
RÍO GRANDE
TASBAPAUNI
SET NET
BLUEFIELDS (TURTLE COMPANY)
CARIBBEAN SEA
N
0 10 20 30 40
MILES

Catching turtles with nets requires little skill; anyone with a canoe can now be a turtleman. The Miskito set thousands of nets daily, providing continuous coverage in densely populated nocturnal habitats. Younger Miskito can become turtlemen almost overnight simply by following more experienced men to the shoal areas, thus circumventing the need for years of accumulated skill and knowledge that once were the domain of the "strikermen." All one has to do is learn where to set the nets, retire for the night, remove the entangled turtles the next morning, and reset the nets. The outcome is predictable: more turtlemen, using more effective methods, catch more turtles.

With an assured market for turtles, the Miskito devote more time to catching turtles, traveling farther and staying at sea longer. Increased dependence on turtles as a source of income and greater time inputs have meant disruption of subsistence agriculture and hunting and fishing. The Miskito no longer produce foodstuffs for themselves; they buy imported foods with money gained from the sale of turtles. Caught between contradictory priorities—their traditional subsistence system and the market economy—the Miskito are opting for cash.

The Miskito are now enveloped in a positive feedback system where change spawns change. Coastal villages rely on turtles for a livelihood. Decline of subsistence provisioning has led to the need to secure food from local shopkeepers on credit to feed the families in the villages and the men during their turtling expeditions. Initial high catches of turtles encouraged more Miskito to participate, and by 1972 the per person and per day catch began to decline noticeably.

In late 1972, several months after I had returned to Michigan, I received a letter from an old turtleman, who wrote: "Turtle is getting scarce, Mr. Barney. You said it would happen in five or ten years but it is happening now."

Burdened by an overdependence on an endangered species and with accumulating debts for food and nets, the Miskito are finding it increasingly difficult to break even, much less secure a profit. With few other economic alternatives, the inevitable step is to use more nets and stay out at sea longer.

The turtle companies encourage the Miskito to expand turtling activities by providing them with building materials so that they can construct houses on offshore cays, thereby eliminating the need to return to the mainland during rough weather. On their weekly runs up and down the coast, company boats bring food, turtle gear, and cash for turtles to fishing camps from the Miskito Cays to the Set Net Cays. Frequent visits keep the Miskito from becoming discouraged and returning to their villages with the turtles. On Saturdays, villagers look to sea, watching for returning canoes. A few men will bring turtle for their families; the majority will bring only money. Many return with neither.

Most Miskito prefer to be home on Sunday to visit with friends and for religious reasons. (There are Moravian, Anglican, and Catholic mission churches in many of the villages.) But more and more, turtlemen are staying out for two to four weeks. The church may promise salvation, but only the turtle companies can provide money.

Returning to their villages, turtlemen are confronted with a complex dilemma: how to satisfy both social and economic demands with a limited resource. Traditional Miskito social rules stipulate that turtle meat should be shared among kin, but the new economic system requires that turtles be sold for personal economic gain. Kin expect gifts of meat, and friends expect to be sold meat. Turtlemen are besieged with requests forcing them to decide between who will or will not receive meat. This is contrary to the traditional Miskito ethic, which is based on generosity and mutual concern for the well-being of others. The older Miskito ask why the turtlemen should have to allocate a food that was once abundant and available to all. Turtlemen sell and give to other turtlemen, thereby insuring reciprocal treatment for themselves, but there simply are not enough turtles to accommodate other economic and social requirements. In order to have enough turtles to sell, fewer are butchered in the villages. This means that less meat is being consumed than before the turtle companies began operations. The Miskito presently sell 70 to 90 percent of the turtles they catch; in the near future they will sell even more and eat less.

Distribution of Turtle Meat by Gift and Purchase

Percent of villagers*	Pounds received per person
18	10–14+
28	6–9
32	2–5
22	0–1.9

During the one-month period from April 15 to May 15, 1971, 125 green turtles were caught by the turtlemen of Tasbapauni, Nicaragua. Of these, 91 were sold to turtle companies; the remaining 34 were butchered and the meat sold or given to villagers. In all, 3,900 pounds of turtle meat were distributed, but 54 percent of the villagers received 5 pounds or less, an insufficient amount for adult dietary protein requirements.

* Population of 998 converted to 711 adult male equivalents.

Social tension and friction are growing in the villages. Kinship relationships are being strained by what some villagers interpret as preferential and stingy meat distribution. Rather than endure the trauma caused by having to ration a limited item to fellow villagers, many turtlemen prefer to sell all their turtles to the company and return with money, which does not have to be shared. However, if a Miskito sells out to the company, he will probably be unable to acquire meat for himself in the village, regardless of kinship or purchasing power. I overheard an elderly turtleman muttering to himself as he butchered a turtle: "I no going to sell, neither give dem meat. Let dem eat de money."

The situation is bad and getting worse. Individuals too old or sick to provide for themselves often receive little meat or money from relatives. Families without turtlemen are families without money or access to meat. The trend is toward the individualization of nuclear families, operating for their own economic ends. Miskito villages are becoming neighborhoods rather than communities.

The Miskito diet has suffered in quality and quantity. Less protein and fewer diverse vegetables and fruits are consumed. Present dietary staples—rice, white flour, beans, sugar, and coffee—come from the store. In one Miskito village, 65 percent of all food eaten in a year was purchased.

Besides the nutritional significance of what is becoming a largely carbohydrate diet, dependence on purchased foods has also had major economic reverberations. Generated by national and international scarcities, inflationary fallout has hit the Miskito. Most of their purchased foods are imported, much coming from the United States. In the last five years prices for staples have increased 100 to 150 percent. This has had an overwhelming impact on the Miskito, who spend 50 to 75 percent of their income for food. Consequently, their entry into the market by selling a subsistence resource, diverting labor from agriculture, and intensifying exploitation of a vanishing species has resulted in their living off poorer-quality, higher-priced foods.

The Miskito now depend on outside systems to supply them with money and materials that are subject to world market fluctuations. They have lost their autonomy and their adaptive relationship with their environment. Life is no longer socially rewarding nor is their diet satisfying. The coastal Miskito have become a specialized and highly vulnerable sector of the global market economy.

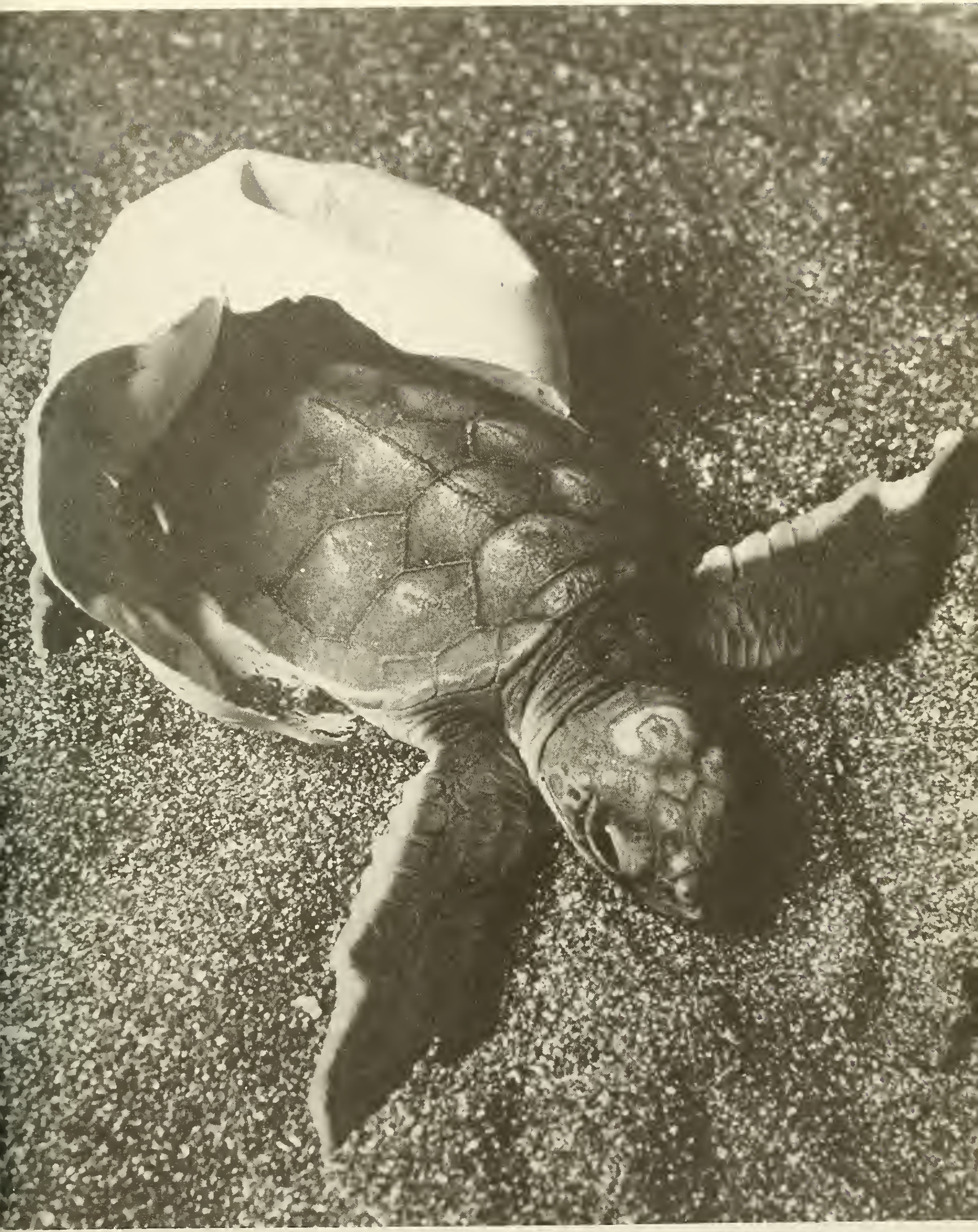
Loss of the turtle market would be a serious economic blow to the Miskito, who have almost no other means of securing cash for what have now become necessities. Nevertheless, continued exploitation will surely reduce the turtle population to a critical level.

National and international legislation is urgently needed. At the very least, commercial turtle fishing must be curtailed for several years until the *Chelonia* population can rebound and exploitation quotas can be set. While turtle fishing for subsistence should be permitted, exportation of sea turtle products used in the gourmet, cosmetic, or jewelry trade should be banned.

Restrictive environmental legislation, however, is not a popular subject in Nicaragua, a country that has recently been torn by earthquakes, volcanic eruption, and hurricanes. A program for sea turtle conservation submitted to the Nicaraguan government for consideration ended up in a pile of rubble during the earthquake that devastated Managua in December, 1972, adding a sad footnote to the Miskito–sea turtle situation. With other problems to face, the government has not yet reviewed what is happening on the distant east coast, separated from the capital by more than 200 miles of rain forest—and years of neglect.

As it is now, the turtles are going down and along with them, the Miskito—seemingly, a small problem in terms of the scale of ongoing ecological and cultural change in the world. But each localized situation involves species and societies with long histories and, perhaps, short futures. They are weathervanes in the conflicting winds of economic and environmental priorities. As Bob Dylan sang: "You don't need a weatherman to tell which way the wind blows." □

Because of predation by birds and fish, only three or four out of 1,000 green turtle hatchlings survive to adulthood.



DAVID HUGHES, BRUCE COLEMAN, INC.

Guns of the Tau Sug

On the strife-torn Philippine island of Jolo, the influx of weapons since World War II has had a deadly influence on tribal and historical feuds

by Thomas M. Kiefer

Tau Sug Riddle: What are all Tau Sug men fonder of than their wives? *Answer:* Their rifles.

When the English adventurer James Brooke, the "white raja" of Sarawak, visited the southern Philippines in the mid-nineteenth century, he observed that the Tau Sug male carried his dagger, or kris, much as the English gentleman had carried his sword—as a symbol of his masculinity and power. To be well dressed at any social affair demanded the wearing of an elaborately decorated kris, which could easily double as a handy weapon for the hot-tempered Tau Sug.

If Brooke were to return today he would observe that while Tau Sug men still carry krises, the symbolic and practical functions of the dagger have been taken over by the modern repeating rifle. This substitution has resulted in prodigious changes in Tau Sug society, not only in the conduct of traditional feuds, but also in the ability of the Muslim Tau Sug to assert their independence in a largely Christian society.

About 200,000 Tau Sug live on Jolo, one of a chain of rugged volcanic islands, stretching from Zamboanga in the northeast to North Borneo in the southwest, which make up the Sulu Archipelago. The Sultanate of Sulu was the northernmost of a series of Muslim trading and raiding states that at one time dotted the coastal regions of the entire East Indies.

Although there are Tau Sug scattered throughout the archipelago, Jolo (pronounced "Holo") is regarded as the political center of the society. The Spanish had tried repeatedly to conquer Jolo Island, but although they were able to establish a small garrison in the town of Jolo in 1878, they never took the interior of the island.

The Tau Sug had probably accepted Islam at least 200 years before the Spanish arrived in the late sixteenth century. Faced with the militant and zealous invaders, the Tau Sug grew firm in both their adherence to Islam and their warlike orientation. The religious and political development of the sultanate was played out against the background of almost constant warfare against the Spanish.

The area came under the domination of the United States after American troops took the Philippines from Spain in 1898.

The United States first tried to govern the Tau Sug by indirect rule through the sultan, but by American standards he was not strong enough to deal with the still rampant piracy and sporadic slave raiding practiced by the Tau Sug against the Spanish Philippines. A pattern of ritual suicide, which had developed in late Spanish times around the Islamic institution of the *jihad,* or holy war, was now di-

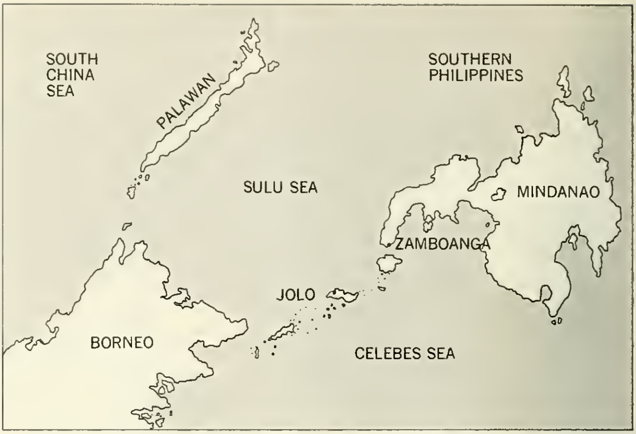
Feuds among the Tau Sug usually take the form of short skirmishes. If anyone is wounded or killed during these encounters, both sides stop firing and retreat.

THOMAS KIEFER

rected against American troops. Even today many Tau Sug point with wry pride to the fact that one model of the classic .45 caliber Colt semiautomatic pistol was developed by the American army primarily to deal with these suicide attacks—in which individuals and groups vowed to die fighting the invaders. The last major battle occurred in 1913, when several hundred Tau Sug died defending a fortified volcanic crater against an attack by American troops. Soon afterward the sultan abandoned all pretensions to secular power but retained his role as religious leader.

From 1913 to 1941 Jolo was under an effective *Pax Americana*, which some of the older Tau Sug still remember with nostalgia. The old single-shot muskets and Mausers used by the Tau Sug were assiduously collected by the American authorities, raiding and piracy declined, and internal feuding between warring factions became more difficult. A national legal system was imposed, unsuccessfully, principally because of the Tau Sug's loyalty to their own customary Islamic law. Slavery, however, was successfully abolished during this time largely because Tau Sug society is quite open and oriented to individual achievement, so that former slaves could easily be fitted into the traditional social structure. But even under American rule, Tau Sug changed largely on their own terms and were by no means swamped by an alien culture.

Some of the most pervasive changes in Tau Sug society, however, were wrought, not by colonial design, but by the introduction of a Trojan horse: the massive influx of repeating firearms during World War II and its aftermath. The standard army issue Garrand and M-1 carbine had been given to Tau Sug guerrillas to fight the Japanese, and these weapons were freely available in the Philippines after the war. The new Philippine government, established after the country gained its independence in 1946, tried to collect the weapons, but the Tau Sug were adamant in their refusal to give them up. In the past, the Tau Sug had relinquished their old muskets and Mausers to the Americans because these firearms were clearly inferior to those carried by Americans; now, however, they carefully guarded the weapons they had acquired during the war because they were on a par with those carried by the Philippine troops.

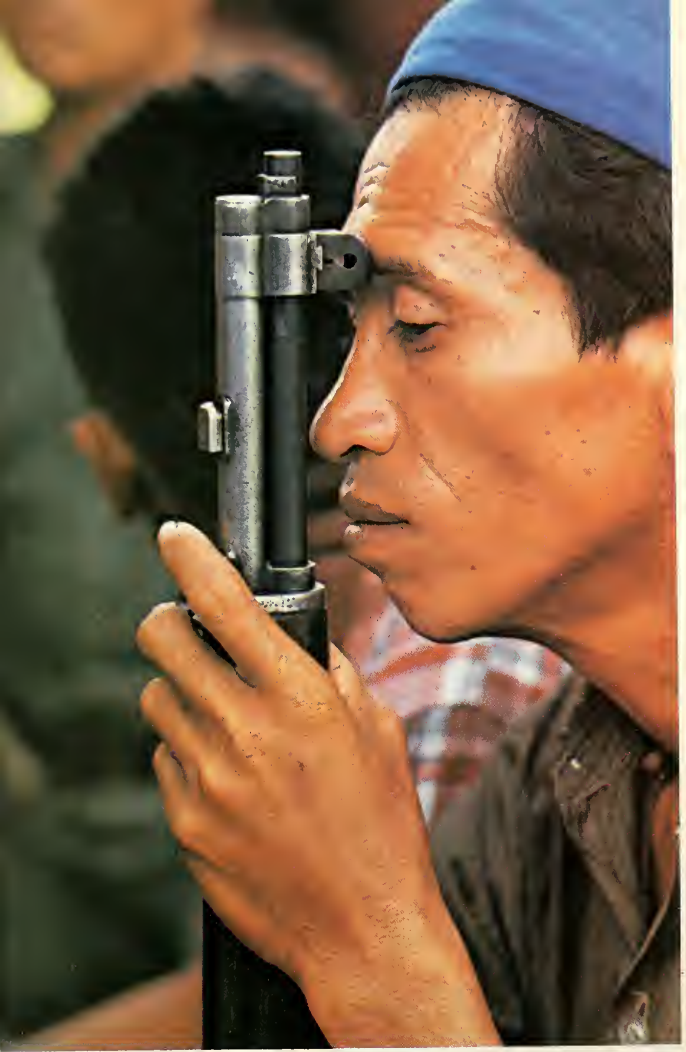


Violent feuding, which had become dormant under American rule, revived, and Jolo became a major trouble spot for the Philippine militia. It remains so today.

Since President Marcos proclaimed martial law in the Philippines in September, 1972, Jolo has become a center of fierce resistance to the Philippine government. This is so for a variety of reasons. First, Christian migration to the island of Mindanao, north of Jolo, has resulted in land conflicts and interethnic tensions with the Muslims living there. Although there is little land grabbing in Jolo—Christian immigrants largely occupy professional, governmental, or skilled occupations and maintain good relations with the predominantly Tau Sug rice farmers and fishermen—many Tau Sug sympathize with their non-Tau Sug Muslim brothers on Mindanao, to the north. Coupled with this is a recent increase in Islamic consciousness, especially among the educated young people, who have been reluctant to migrate but find it increasingly difficult to find suitable work on Jolo. The government, in an effort to legitimize its position, vis-à-vis the United States and the sensitive Muslim world, claims that some of the young men among this growing unemployed intelligentsia have become Maoists.

Another factor in the current rebellion is a hazily formed desire for an independent Sulu nation. In 1968, when I was finishing two years of research in Jolo, most Tau Sug I spoke with said casually that they preferred independence or affiliation with a Muslim nation such as Malaysia or even a return of the United States. But it was only a vague attitude and lacked leadership; local leaders were more interested in advancing Tau Sug demands and their own personal futures within the raucous system of Philippine politics. Although many Tau Sug leaders remain loyal to the government, as much from internal factionalism as from genuine ideological commitment, the sentiment for independence has crystallized considerably. Some younger leaders have joined the rebellion; even the mayor of Jolo, along with the eighty-man police force, went over to the rebels in February, 1974, although the mayor returned nominal support to the government in March.

Finally, and of most immediate importance, martial law has increased the power of the Philippine army, which is becoming increasingly intransigent with regard to the Tau Sug. Before the imposition of



Most Tau Sug men own a rifle or can borrow one on short notice. Rifles are usually of World War II vintage, but some more sophisticated arms have been smuggled in recently.

CREDIT—TED SPIEGEL

martial law a kind of working "misunderstanding" prevailed between the enforcement of national law and the traditional Islamic law of Jolo. Educated Tau Sug politicians, officially operating within Philippine electoral politics, but with one foot firmly in the traditional system, served as informal mediators to mute the potential influence of the army.

Although the militia command on Jolo is one of the largest in the nation, it is relatively weak vis-à-vis the heavily armed Tau Sug. Through the pressure of politicians as cultural mediators, rural Tau Sug largely use national law to further, rather than to settle, their internal disputes. A man goes to Philippine courts mainly because he wishes a warrant of arrest issued against his enemies, thereby gaining the support of the militia in his own private feud. But when he wishes settlement, he goes to Tau Sug law.

The militia was a relatively weak, but nevertheless useful, nuisance that the Tau Sug learned to tolerate but never quite accepted. Martial law has changed this situation. As political accommodation became more difficult, the rural Tau Sug looked to their weapons. The militia's attempt to collect unlicensed firearms triggered an uneasy situation. For every three adult Tau Sug males there is at least one firearm—about 90 percent of these are unregistered. Conflict became fiercer in February and March; heavy fighting and fires practically destroyed the town of Jolo, and thousands of refugees have streamed into Zamboanga.

The current situation is very much in flux. Nevertheless, the Tau Sug are still able to assert their cultural integrity, although some other minority peoples in the Philippines have been overwhelmed by land grabbing, logging, so-called economic development, and plantation agriculture. This is because, with the exception of the town of Jolo, the Tau Sug are totally in control of their own island, and because they possess—and are willing to use—firearms.

Gunpowder was introduced to Southeast Asia before it reached Europe, and the Tau Sug have owned rifles since at least the seventeenth century. Apart from the later Spanish period, however, it has only been since World War II that firearms have been present in sufficient quantity to affect the conduct of political and social life. Firearms have increased the homicide rate, altered the traditional basis of Tau Sug violence, decreased the complexity of alliances, and indirectly influenced the growth of cash-crop agriculture.

Tau Sug politics are characterized by a great emphasis on leader-centered factionalism. Although there are some concentrated settlements near the coasts, most rural

Tau Sug live in dispersed homesteads near their rice farms, allied to nearby farmers by overlapping kinship bonds and loyalty to a common headman. Headmen differ greatly in the extent of their power; some govern only a few homesteads connected by kinship; others control large regional areas. A headman's power depends on the support of his immediate kinsmen, his legal skill and charisma, his wealth and largess, and the support of a group of younger kinsmen and allies who will support him with violence if necessary. Headmen are often given traditional titles by the sultan to symbolize their power and are sometimes elected to local posts in the national government.

Local factions almost always unite with other factions to form larger alliances, which are frequently sanctioned by pacts of ritual friendship sworn upon the holy Koran. While alliances created in this way are extremely fluid and likely to last only as long as practical, pyramidal alliances and pacts of friendship enable the Tau Sug to assemble large fighting forces, numbering hundreds or even thousands of men. By modern military standards these "armies" are a motley assortment of undisciplined men, but they serve their purpose well.

Military alliances are created to conduct feuds engendered by legal conflicts involving homicide, theft of cattle and other property, questions of land ownership, and more subtle issues involving masculine honor and shame. Many conflicts are settled before they reach the stage of active feud, and feuding participants usually recognize that sooner or later they will have to settle each case through mediation by traditional leaders.

One effect of the widespread availability of firearms has been a decrease in the extent and importance of larger military alliances. In 1967 I witnessed an incident that illustrates this change quite typically. A young man, Hadjan, had gone to a seaside market where he accidentally met his enemy Abdul. Hadjan and Abdul had never fought before, but Abdul suspected that Hadjan had fired his rifle at him several nights before over a minor grievance. They argued at the market and were soon fighting with krises. Abdul grabbed a gun carried by a friend and attempted to shoot, but was restrained by the crowd.

That evening a group of forty armed men from Hadjan's community, together with an additional twenty allies from a nearby community, attacked Abdul's house. Abdul was able to muster only three supporters, but his house was surrounded with barbed wire and thicket, and the four armed men were able to stand off the attack, which lasted half the night. This case demonstrates that repeating rifles make it possible for a man to defend himself against considerable opposition. If this fight had been fought with bladed weapons and single-shot rifles, Abdul would certainly have been killed. Given the fact that the major reason a Tau Sug seeks alliances is for protection and mutual support, one effect of repeating firearms has been to decrease the need to seek alliances.

In 1968 there was approximately one firearm for every three males in the region of eastern Jolo in which I was working. Some guns were left over from World War II, but most had been purchased from smugglers or taken from the militia. It is possible that some weapons have recently come in from North Borneo. In addition to their practical uses, guns are regarded as a good investment. A carbine that cost 170 pesos ($50) in 1950 may now be worth 2,000 pesos ($300). Money to purchase guns comes mainly from cash-crop agriculture, primarily copra and abaca (Manilla hemp), which are bought by Chinese middlemen for the world market. In one municipality an average family spent 30 to 40 percent of their cash income for firearms and ammunition. Almost everybody I spoke to remarked that a major reason for converting valuable rice land into coconut orchards was to obtain the cash to purchase firearms.

Families usually had enough money left over to purchase imported rice. This made economic sense in 1968, but since then rice prices have risen rapidly, copra prices have fluctuated, and orchards are not easily turned back into

TUS
VEGETABLE
COOKING OIL

farmland. Today the Tau Sug are consuming less rice; in its place they are planting and eating starchy root crops.

The traditional Tau Sug legal system emphasizes the principle of self-help, in which the primary responsibility for redress of an injustice rests with the victim himself. Ideally, the drive toward revenge is tempered by public opinion and community standards of morality. Common belief is that it is very dangerous for a man to refrain from publicly announcing his intentions, because if he keeps his anger "inside his liver," wise counsel will have no influence on his actions.

Repeating firearms, however, have made it possible for a man to seek vengeance individually, by setting up an ambush at night, shooting through the floorboards of a house, or firing at long range. Previously it was difficult, although not impossible, to take revenge without the active support of kinsmen and friends. To ambush an enemy with only a bladed weapon required the assailant to present himself, and if the ambush failed, the intended victim would surely identify the culprit and want to take retribution. If a man had doubts about the propriety of an impetuous action, he knew that his kinsmen and friends might only support him half-heartedly if a full-blown feud developed. Before the use of repeating firearms, people usually knew who had killed whom and for what reasons. Also the moral basis of the activity was on firmer ground. Today, killings by unknown assailants for unknown reasons are more frequent, and the tranquility of a community may be disrupted as speculative rumor runs wild and people make accusations based on only the vague evidence of half-forgotten grudges.

The mayor of Jolo, far right, attempts to calm a group of his feuding constituents. Politicians are often caught between their Tau Sug heritage and their administrative roles.

TED SPIEGEL

BP
2

Accidental shootings have also increased; many escalate into feuds. In one case that occurred in 1968, two second cousins, both on the alert for personal enemies, met on a path one dark night. They stopped short before they could recognize each other, and because the Tau Sug observe a taboo against the personal use of one's own name, they were unable to call out their identity and shot each other. At the funeral I asked an elderly man if he had ever heard of a similar case in the old days. He remarked that without guns it never could have happened, but added that it was a good thing they both died, otherwise the community would surely have been split by a serious feud.

The homicide rate has climbed rapidly since the end of World War II, but it is impossible to obtain accurate figures: neither the militia, government courts, nor municipal police forces keep usable statistics. But I was able to obtain an accurate record of all homicides kept by the punctilious vice-mayor of one municipality for the years 1964 to 1966. During this two-year period there were 114 killings. The militia was responsible for an additional eleven deaths. At least 90 percent of the homicides involved approximately 5,000 males between the ages of twenty and fifty. Based on population estimates, the annual homicide rate for males in that age group was 1.3 percent. For a young man of twenty there is a 35 percent likelihood that he will be shot by the time he is fifty. This situation is reflected by the large number of unmarried women and widows compared to men, although some of the difference is taken up by polygyny.

This high death rate actually reflects a decline from the truly astronomical rate reached immediately after the war. In those years firearms were unequally distributed; some former guerrilla bands were well armed, while other communities had few guns. Cattle theft increased dramatically because some owners were without means of defense. Since guns are a major, although perhaps not legitimate, determinant of power, there was a period of intense conflict until guns became more equally distributed and a new balance of power was achieved. Slowly the situation was redefined in a manner that took the new weapons into account. As more men gained access to guns, the homicide rate began to fall slightly.

One reason a Tau Sug feels compelled to own firearms is simply that his potential enemies have them. But as an anthropologist I felt it was important to look closely at the subtle symbolic attachment to a firearm, the feature James Brooke had noticed about the kris. Tau Sug males have a fascination with firearms comparable to our own interest in automobiles. They constantly clean them, pamper them, talk about them, compare them, test them, and admire them. They use perhaps half of their scarce ammunition in purely ceremonial ways: guns are shot at births, weddings, religious occasions, and all life-crisis rites except funerals. Men shoot at the ghosts of the dead, and during an eclipse, rounds of ammunition are shot at the sun. Each weapon is treated in an individual, almost personal way. The unique sound of each firearm is known to all in the community. Many times a lone shot would ring out several miles away, and I would ask, "Is there a fight over there?" "No," the reply would come, "it is only Achmad playing around."

Firearms are extensions of the male self. This symbolism is by no means unconscious. The nomenclature for parts of the weapon abounds in explicit sexual reference. The barrel hole is the "vagina," the firing pin is the "little penis," and so forth. I never saw a woman carry a gun, and the idea that a female could sensibly fire one is laughable to the Tau Sug. Since not every Tau Sug man owns a gun, an elaborate system of borrowing firearms has developed among kinsmen and friends. At any large social gathering about four of every ten guns will have been borrowed.

While the Tau Sug have a warlike social structure, they are not personally bellicose. They are quick to anger, but equally quick to love and pity. They do not teach their children to fight; they teach them that fighting is ultimately wrong. But if it is a man's fate to "do what he has to do" to restore honor and vindicate shame through vengeance, they respond with vigor. One reason Tau Sug have a very fond memory of the United States is that—rightly or wrongly—they attribute to Americans some of their own ideal virtues. Americans are thought to be honest, fair, honorable, and brave: stereotypes that were helpful to my research in some situations, but embarrassing in others.

Some Tau Sug wonder why the United States, through its military assistance programs, apparently supports the Philippine government in its effort to achieve a military solution to the current rebellion. In the long run only a political accommodation is likely to bring the Tau Sug into the Philippine nation on their own terms and not merely as a second-class minority. The Philippine government will have to give up the mistaken idea that poverty and a lack of education are the underlying causes of the Muslim rebellion. It will have to acknowledge that its past policies have not seriously respected the integrity of Tau Sug culture. The Tau Sug will not be content merely to become lowland Filipinos, with perhaps a bit of religious freedom, quaint dances, and unique marriage customs thrown in as a sop to local pride and to attract the tourist trade. I cannot predict what such a political accommodation will be, but the Tau Sug ability to compromise (when it does not conflict with their basic values) will hopefully prevail.

In the meantime, military thinking predominates on all sides. Reflective Tau Sug say, correctly, that firearms have changed their culture and are certainly a source of many of their troubles, but that without them they probably could not remain Tau Sug. □

The government militia is always prepared to move into the interior of the island to quell feuds. The Tau Sug, however, generally ignore the militia's presence.

TED SPIEGEL

Celestial Events

by Thomas D. Nicholson

Sun and Moon The sun reaches its most northerly position in the sky on June 21, when it arrives at the summer solstice, and the summer season begins in the Northern Hemisphere. June 21 is also the day when the sun is above the horizon longest, although the earliest sunrise occurs on June 13 and the latest sunset on June 27. By the end of July and early August, the days are perceptibly shorter as the sun's southward motion accelerates.

Look for evening moonlight during the last two weeks of June and July, with the nearly full moon in the sky all night during the first several days of each month. Phases are: June 19, new; June 26, first-quarter; July 4, full; July 12, last-quarter; July 19, new; July 25, first-quarter; August 2, full; August 10, last-quarter. Neither the partial lunar eclipse of June 4 nor the total solar eclipse of June 20 will be visible in North America.

Stars and Planets Summer skies contain stars of three seasons during the early evening: those of spring (Leo and Virgo) in the west, those of summer (Lyra, Cygnus, Aquila) rising in the east, and some of autumn (Pegasus and Andromeda) coming above the eastern and northeastern horizon.

The best meteor shower of the year, the Perseids, reaches maximum on August 12, but you may expect to see twenty-five or more meteors per hour from the shower on any clear morning from the 10th to the 14th of the month. The waning moon will rise about midnight, but should not be so bright as to obscure the usually bright Perseid meteors. The less productive Delta Aquarid shower reaches maximum (twenty per hour) on July 29.

Mercury, Mars, and Saturn are in the evening sky during June, but only Mars is visible, and even it is low, dim, and difficult to see in the western sky after sundown. In July, Mercury and Saturn join Venus as morning stars. Jupiter, this summer, rises during the first half of the night and remains visible all night long. By late July, the dawn sky is beginning to get interesting, with Jupiter in the west and Saturn and Venus near one another low in the east. Mercury may be seen as a morning star, below Venus and Saturn from about July 20 to July 30.

June 17: Mercury begins retrograde motion.

June 21: Summer begins. Solar eclipse occurs in the Indian Ocean. The moon is at perigee (nearest earth).

June 22: Mars is near the crescent moon tonight.

June 30: Saturn and Mercury are in conjunction with the sun; both enter the morning sky.

July 4: Earth is at aphelion, farthest from the sun for the year at a distance of 94,507,000 miles.

July 6: Moon is at apogee (farthest from earth).

July 8: Jupiter begins its retrograde motion.

July 9: Jupiter rises near the moon tonight.

July 11: Mercury ends its retrograde motion.

July 19: The moon is at perigee ten hours after its new phase. Perigee spring tides will bring above average high water.

July 22: Mercury is best as a morning star.

July 24: Mercury is in conjunction with Saturn.

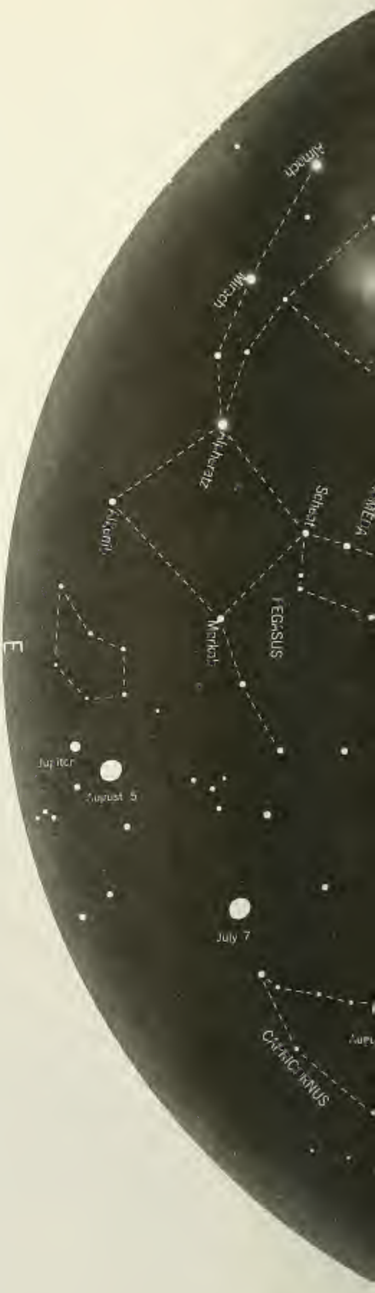
July 31: Venus is in conjunction with Saturn.

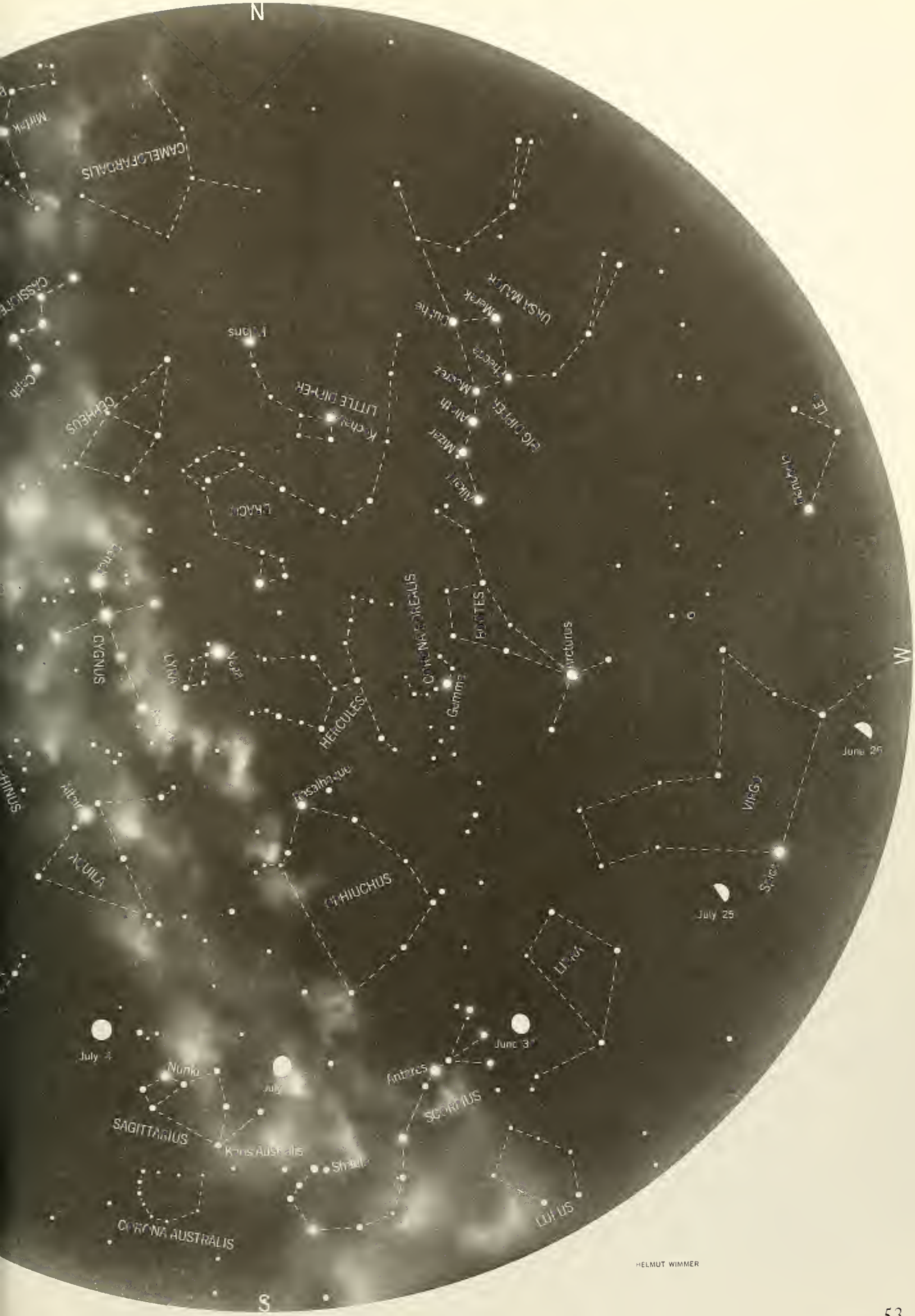
August 2: Moon is at apogee.

August 5: Jupiter rises near the moon tonight.

August 15: Saturn is near the moon this morning.

★ Hold the Star Map so the compass direction you face is at the bottom, then match the stars in the lower half of the map with those in the sky near the horizon. The map is for 12:25 P.M. on June 15; 11:25 P.M. on June 30; 10:25 P.M. on July 15; 9:20 P.M. on July 30; and 8:25 P.M. on August 15; but it can be used for about an hour before and after these times.




N
W
S
Mirfak
CAMELOPARDALIS
CASSIOPEIA
Caph
Polaris
CEPHEUS
LITTLE DIPPER
Kochab
DRACO
URSA MAJOR
Merak
Dubhe
Phecda
Megrez
Alioth
Mizar
Alkaid
BIG DIPPER
LEO
Denebola
Deneb
CYGNUS
LYRA
Vega
CORONA BOREALIS
BOOTES
Arcturus
Gemma
HERCULES
Rasalhague
OPHIUCHUS
Altair
AQUILA
VIRGO
Spica
June 25
July 25
LIBRA
June 30
July 4
July
Nunki
Antares
SCORPIUS
SAGITTARIUS
Kaus Australis
Shaula
LUPUS
CORONA AUSTRALIS

HELMUT WIMMER

The New Town Bird Quadrille

A prairie hornlark perched on the roof that covered the house that stood in the field that was last year's mating ground

by Aelred D. Geis

Across the United States, a number of carefully planned and landscaped cities have sprung up in recent years. While open fields and woodlots are still churned into oblivion by earth-moving machinery, the destruction of natural habitat in planned communities is usually not as great as in a typical suburban tract development. More trees are left standing; more open space is retained for esthetic and recreational purposes; more areas are planted with grass and ornamental shrubs.

Nevertheless, the inevitable habitat changes do destroy, upset, or modify the floral and faunal composition of the area. For a wildlife biologist the construction of a new city presents an unparalleled opportunity to study the changes that occur in numbers and diversity of species when people build homes and move into a previously undeveloped area. Base line data from the period when the site was undisturbed can be obtained, and as development progresses, yearly changes can be carefully monitored and related to the number of houses, type of construction, population density, and other factors. In this manner a cause and effect relationship between numbers and species of wildlife and numbers of people and kinds of houses can be established.

Among the more visible forms of wildlife in urban areas are birds. Several species have adapted successfully to life in proximity to humans; some have even increased their populations. Others have declined or disappeared. The reasons for the success or failure of a bird species in a city environment are not always clear. Factors other than the destruction of natural habitat seem to be involved; but to know definitely, we must trace the population history of a species through the changes in habitat caused by urban development.

Prior to 1966, when initial construction began, the present site of Columbia, Maryland, situated between Baltimore and Washington, D.C., was one of the few remaining rural areas in the Boston–Washington megalopolis. Studded with fields, woods, and streams, this 14,000-acre agricultural site was inhabited by a wide diversity of bird species. The construction of Columbia afforded an excellent opportunity to record the effects of urbanization on different bird populations because the well-defined development occurred very rapidly. Also, because the new buildings ranged from detached homes of various types to apartments, it was possible to study the adaptations of various species to different types of buildings.

To monitor the effects of urban development on bird populations, the U.S. Bureau of Sport Fisheries and Wildlife established survey routes where early morning bird counts were made from 1966 through 1971. During this period the region changed from sparsely populated farmland to a community of more than 30,000 people. Counts measured breeding populations in June and winter populations in January—two months when bird populations are most clearly defined by habitat conditions. (In 1972, the

Mockingbirds are one of several species whose numbers are increasing with urbanization.

F.J. ALSOP, III, BRUCE COLEMAN, INC.

study entered a second, more intense phase designed to relate bird populations to habitat conditions in a more precise way.)

A general impact of urbanization on bird populations is reflected by the surveys conducted between 1966 and 1971. Typical farmland species, such as the bobwhite and the mourning dove, showed dramatic declines as agricultural fields disappeared and the area became less attractive for feeding.

Such field-inhabiting species as eastern meadowlarks, red-winged blackbirds, and grasshopper sparrows also declined sharply. The wood thrush and indigo bunting,

F.J. ALSOP, III, BRUCE COLEMAN, INC.

As its favored pine trees disappear and grainfields are covered with houses, the mourning dove (left) declines in numbers. The cardinal (above) seems to be more adaptable, as it can find sufficient food in developed areas.

THASE DANIEL, BRUCE COLEMAN, INC.

which are woodland and woodland-edge species, respectively, also showed dramatic reductions. All of these farmland, field, and woodland species no doubt declined because of the striking reduction in the amount of suitable habitat as the area became covered with houses and other development. Field-nesting species may have had difficulty reproducing successfully because of increased nest predation by house cats. As more people moved into Columbia, greater numbers of cats were seen hunting birds. Most low nests were destroyed by cats before the nestlings fledged.

Cardinal populations showed no consistent change, and the counts in Columbia trended up and down in the same direction as statewide counts in the Nationwide Breeding Bird Survey.

Several native species increased with urbanization, especially mockingbirds, chipping sparrows, and song sparrows. These species prefer the shrubs and lawns that are a consistent feature associated with the new houses in Columbia. A striking increase in mockingbirds is believed to be related to the large number of fruit-bearing shrubs planted for ornamental purposes. House wrens, although present in low numbers, increased in the area because Columbia residents set out bird houses—many of which provided ideal nesting sites for this species.

Remarkable population increases were recorded for starlings and house sparrows. These species, virtually absent before development, were the most common species after development. Studies of building design clearly demonstrated that the most important factor responsible for the high starling and house sparrow populations was the style of house construction. Unboxed eaves often had small openings beneath the roof, which afforded starlings and house sparrows access to attractive nest sites. Widely louvered air vents also provided nesting cavities for house sparrows. These two architectural features were largely responsible for the differences in populations between these two species in various parts of Columbia.

WILLIAM S. PEARSON, JR., NORTHWAY STUDIO

Annual Breeding Bird Counts,
Village of Wilde Lake, Columbia, Maryland

Species	1966	1967	1968	1969	1970	1971
Decreasing:						
Bobwhite	37	37	35	28	23	9
Mourning dove	17	12	11	7	5	4
Wood thrush	16	15	6	5	4	2
Eastern meadowlark	16	13	12	10	3	6
Red-winged blackbird	9	12	8	7	2	1
Indigo bunting	14	13	9	5	3	2
Grasshopper sparrow	15	17	10	9	3	2
No change:						
Cardinal	4	7	6	7	6	5
Increasing:						
House wren	0	0	1	2	2	3
Mockingbird	1	4	5	11	11	10
Starling	1	8	15	13	37	32
House sparrow	0	0	3	15	26	20
Chipping sparrow	0	1	1	9	7	12
Song sparrow	4	6	9	12	14	12

Changing habitats and favorable housing design details worked together to influence bird numbers and variety. Construction areas received very low bird use, probably as a result of the severe disturbance. In such areas, starlings and song sparrows were the most common species: song sparrows tended to utilize small islands of shrubby cover that were often retained on the building sites, while starlings sometimes attempted to nest in partially completed houses.

Detached homes built in wooded areas where many of the original trees were retained had the most varied species composition among the developed areas. An unanticipated result was the great variability observed in the occurrence of starlings and house sparrows on such sites. In one situation, starlings and house sparrows made up only 11.5 percent of the birds recorded in contrast to another, similar area where these species made

Construction of the planned community of Columbia, Maryland, which covers 14,000 acres of former agricultural land, has resulted in sharply reduced populations of many open field and woodland bird species. House sparrows, however, have found the development a boon. Building design features such as unboxed eaves and protruding signs provide ample nesting sites for this species. A male sparrow (right) inspects an abandoned swallow nest for its own use.

CHUCK BOWEN

ETHEL M. ORPEN

up more than 50 percent of the birds present. This difference was due solely to such building design features as unboxed eaves and louvered air vents. In this wooded region, robins, grackles, blue jays, and catbirds—attracted by remaining portions of the original forest floor and ornamental shrubs planted by residents—were present in similar numbers in the areas with both high and low starling and house sparrow populations.

Bird population levels associated with detached homes built in originally open areas were also quite variable. Much of this variability resulted from differences in house sparrow populations, which again, could be charged to building design. Sections with widely spaced, louvered air vents had high house sparrow populations. The number and age of trees and shrubs in these areas also influenced bird populations.

The greatest density of birds, consisting almost entirely of starlings and house sparrows, was associated with townhouses and apartments. More than twice as many birds were observed in these areas as elsewhere. Starling and house sparrow populations associated with apartment buildings also tended to be influenced by the characteristics of the eaves and by open lattice work used to camouflage air conditioning systems. The highest bird population recorded in this study occurred near apartment buildings having lattice work that provided excellent nest cavities for house sparrows and starlings.

We occasionally found birds outside of their normal habitats because of the great rapidity of habitat change in the fast-developing new community. For example, grasshopper sparrows were found singing on newly sodded lawns, while prairie hornlarks sat on roofs. In both instances, the birds had probably returned to breeding areas that had been open fields the previous year only to find them covered by houses.

A factor operating against birds in urban situations is the tendency of many people to prefer highly manicured landscapes—a tendency usually expressed in the management of commonly owned open space. In planned communities, such as Columbia, the principal management practice is mowing. Urban open areas would have much more varied bird populations and opportunities for environmental education if some natural vegetation were permitted to develop, and if nonplay areas now maintained in grass were converted to trees and shrubs. There are encouraging signs that the demands for a "spit and polish" environment are lessening

Where some original trees remain, blue jays (right, perched near hornets' nest) survive in numbers. Chipping sparrows, below, do well in areas that combine open fields, shrubs, and trees.

THASE DANIEL, BRUCE COLEMAN, INC.

and better habitat planning is beginning to prevail.

While the research reported here is just beginning to shed light on some of the factors affecting urban bird populations, some general principles are already emerging. As areas develop, the species composition changes greatly. Field, farmland, woodland, and woodland-edge species decline while species that utilize shrubs and lawns (chipping sparrows and mockingbirds) or share man's housing (house sparrows and starlings) increase. Comparisons of bird populations associated with various densities of development show that the variety of species declines while absolute numbers increase (in this study, due to starlings and house sparrows) as development intensifies.

Perhaps the most significant result so far is the observation that the style of building construction has a marked effect on starling and house sparrow populations. The propagation of these species should be discouraged. Their adverse effect on native hole-nesting birds, such as red-headed woodpeckers, flickers, and bluebirds, caused by competition for nesting cavities is of concern to many ornithologists. Appropriate landscaping around homes and retention of natural habitat in developed areas can insure more varied bird populations that will make urban areas more interesting places in which to live. ☐

F.J. ALSOP, III, BRUCE COLEMAN, INC.

Are We Alone in the Cosmos?

Water is the elixir of life. It is essential not only for life as we know it but for almost any form of life that can be imagined on an earth-like planet. Because the earth has water in abundance, it offers a congenial home to life. The moon is bone-dry, and that is why it is almost certainly lifeless.

Mars is wetter than the moon, but drier than the earth. The trace of moisture in its atmosphere is possibly sufficient to support any existing forms of life, but would not have been adequate to permit life to originate on the planet initially. For that, it would have been necessary to have an abundance of water in liquid form on the surface of Mars. Did the planet once contain a large amount of water? Photographs of Mars taken by the Mariner 9 spacecraft have been analyzed for clues to the resolution of this critical question, and the results are startling in their implications.

An ample supply of water is essential for the origin of life because water provides a fluid medium in which amino acids and other basic molecules of the living cell can drift freely about. Moving at random, they often collide. Such collisions are important because they provide the chance for each molecule to come into repeated contact with other molecules. Now and then, two small molecules will collide at just the proper angle so that one will fit into the other, like a plug into a socket. When a pair of molecules meets in this way, they join together to form a new and larger molecule. Many such collisions build up in stages the giant molecules of the cell—DNA, RNA, and proteins—out of the small molecular building blocks of living matter.

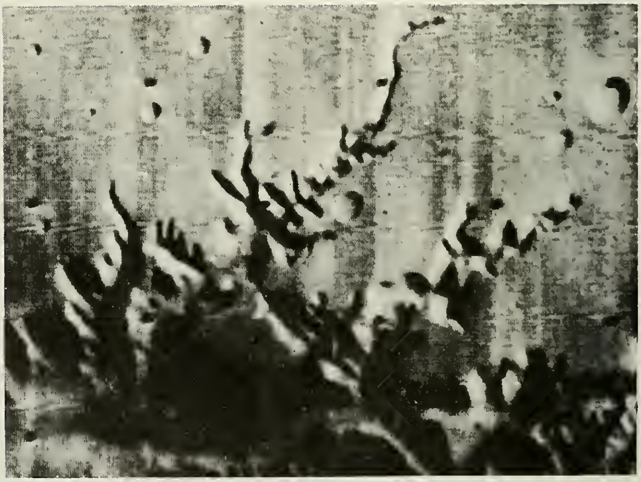
Without frequent collisions between smaller molecules, DNA and proteins would never form; without a watery medium, there would be no collisions. Other substances, such as liquid ammonia, could play a similar role, but the temperature would have to be very low. Ammonia, for example, must be cooled to about –26°F. to become a liquid: at the temperatures prevailing on the earth, it can only exist in the form of a vapor.

That is why water is essential to life on the earth and its neighbors, and why there is no life on the moon. Even if all the amino acids and other chemicals of life were abundant on the moon, they could never unite to form the simplest living organism: in the absence of water, they would be unable to move about and collide with one another.

With the moon eliminated, what are the prospects for finding life on our next nearest neighbors, Venus and Mars? Consider Venus first. The earth's sister planet, Venus, is nearly the same in size and weight, but it is situated thirty million miles nearer to the sun. Venus, obscured by a permanent cover of clouds, was once thought to be a tropical paradise, but we now know that the planet is a hellhole. Although a small amount of quintessential water was detected in Venus's atmosphere by a Soviet spacecraft, it is in the form of superheated steam because the temperature on the surface of Venus is a sizzling 800°F., hot enough to melt lead. Moreover, the dense clouds on Venus are probably made of corrosive droplets of sulfuric acid. No life conceivable to earthlings could survive such terrible conditions.

What about Mars? This planet, half the size of the earth, is about fifty million miles farther from the sun. Mars has a more agreeable climate than Venus, cold but not unbearable, with Antarctic temperatures during the winter and heat waves that bring the thermometer up to 70°F. on its equator during the summer. A trace of moisture exists in the atmosphere, equivalent to a film a thousandth of an inch thick. Although this small amount of water is inadequate to permit life to originate, it could support life that had evolved earlier, in a wetter and more favorable age, and had then adapted slowly to drier conditions. All in all, as an abode of life, Mars is more promising than either the moon or Venus.

But when the first closeup photographs of Mars were taken by Mariner 6 and 7 in 1969, they revealed



a very discouraging picture. The planet's surface, pocked by craters and apparently unchanged for eons, looked like the barren moon. There were no signs of water erosion, such as rilles, canyons, gullies, or empty river beds. The presence of these dry channels would have indicated the existence of an abundance of water in the past; their absence seemed to prove that Mars has always been relatively dry and life could never have originated there.

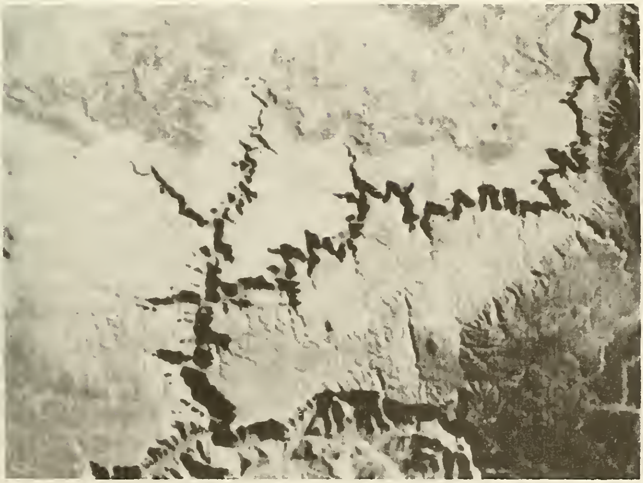
After the Mariner flights, the prospects for finding even the most primitive plants or bacteria on Mars seemed very poor, and a NASA report concluded, "Nothing in the data from Mariner 6 and 7 encourages the belief that life existed on Mars. . . ." A *New York Times* editorial referred to Mars as "The Dead Planet," and C. P. Snow, ruminating on the philosophical implications of the failure to find life on either the moon or Mars, wrote, "The solar system is a desperately disappointing place. . . . Our planet [has turned out to be] a peculiar fluke in a dead system."

But the flame of hope was not entirely extinguished by the adverse facts learned from Mariner 6 and 7, for the human desire to populate the emptiness of space with other beings is very strong, and in the quest for extraterrestrial life, the stakes riding on Mars are very high. What are these stakes? According to current ideas on the formation of solar systems, our galaxy has about one hundred billion stars similar to the sun, many of them with earthlike planets. An additional ten billion galaxies, each with a comparable number of stars and planets, are within range of the largest telescopes. How many of these innumerable planets are inhabited by any kind of life? The answer depends on the probability that life will develop on an earthlike planet. If this probability is as small as one in a million or one in a trillion, we may be alone in our galaxy or alone in the universe. If the probability is as high as one in ten or even one in a thousand, the universe is teeming with life.

Scientists tend to feel that since the earth is an undistinguished planet, the existence of life here proves that life, and even intelligence, must be common in the universe. While I share their optimism, there are no objective grounds for it; only the wishful thought that life will arise wherever conditions allow. The contrary may be true; the evolution of life out of nonlife may be a near-miracle of extremely low probability; the earth may be the only planet so favored in this galaxy and, perhaps, in the cosmos.

The earth by itself cannot tell us the crucial probability for life arising on a planet. Mars, however, can reveal the answer. Suppose that life is discovered on Mars; we will then know at once that the chance of life evolving on an earthlike planet is roughly two in three, since two of the three promising planets in the solar system—Earth, Mars, and Venus—would have been the scene of that event. This estimate, based on only a few planets, would not be precise; the accurate results might be one in three or one in two, or even as low as one in ten; but we could be confident that the probability is not as small as one in a million or one in a trillion.

The importance of this line of reasoning is very great. Life on one planet tells us nothing about life in


NASA

The Martian canyon Valles Marineris *is approximately fourteen times as long and up to four times as wide as the Grand Canyon. An enlarged view of a small part of its south rim (left) and a satellite shot of the Grand Canyon (right) look amazingly alike. The branching tributaries of the Grand Canyon were created by the flow of water over millions of years. The same process may have caused the branching canyon channels on Mars.*

Who's doing anything about MY environment?

AUDUBON is!

Yes, our frustrated friend, for 76 years, AUDUBON has been fighting to save your natural environment. Your wild friends have benefited too...and so have a good many human beings.

Humans! Join the National Audubon Society and you'll not only support its farflung conservation programs but you'll receive, six times a year, *AUDUBON* magazine—one of the most impressive and significant nature magazines in the world. In addition to superb color photography, noted writers and gifted nature artists, *AUDUBON* brings you the latest intelligence in the conservation field. And, at no extra cost, you can belong to one of the Society's more than 300 local chapters!

The National Audubon Society is not for those who have given up hope in tomorrow. It is for those who believe in and support positive action to conserve our wildlife and wilderness, natural resources and natural beauty.

If you too refuse to give up, come join us!

NATIONAL AUDUBON SOCIETY
Dept. E729, 950 Third Avenue
New York, New York 10022

I'm with you! Send me a year's six issues of *AUDUBON* and count on my support.

☐ Individual/$12 per year ☐ My check is enclosed
☐ Family/$15 per year ☐ Please bill me later

Name ____________

Address ____________

City ________ State ______ Zip ______
Membership dues tax deductible to the extent allowed by law

the universe; life on two planets within a single solar system would tell us nearly everything.

Whether for this reason or perhaps another, NASA decided to take a closer look at Mars. In May, 1971, Mariner 9, a greatly improved spacecraft, was launched toward Mars with new TV cameras designed to produce sharper images than those achieved in previous flights. More important, while the old Mariner had flashed past Mars with only a quick glance at a small area, the new Mariner was designed to drop into orbit around the planet and become the first artificial Martian moon. It would take photographs and instrument readings continually over a period of months or years, map the entire surface of Mars for the first time, and view areas never seen before.

The photographs have now been thoroughly analyzed, and the results are totally unexpected. It turns out that the glimpse of Mars obtained during the earlier Mariner flights gave a misleading impression of the planet. One part of Mars—the part that happened to be in view from the 1969 Mariner as it flashed past the planet—is covered with craters and resembles the moon. But other parts—never seen at close range until Mariner 9 photographed them—are more like the earth, with volcanoes, arroyos, and signs of geologic activity and water erosion unlike anything seen on the moon.

The most conspicuous object in the photographs is a giant volcano similar to such volcanoes on the earth as Mauna Loa in Hawaii. This Martian volcano, named The Snows of Olympus (*Nix Olympica*), is a mammoth cone of lava, 300 miles across at the base and nearly 70,000 feet high, or twice as large and twice as high as the largest volcanoes on the earth. Three other giant volcanoes have been photographed, as well as about a dozen smaller ones, each respectable in size by terrestrial standards.

Martian volcanoes resembling Mauna Loa are a discovery of the greatest importance. On the earth, such volcanoes are produced by molten rock rising to the surface and piling up in a mound of congealed lava. The molten rock carries to the surface many gaseous compounds that were trapped in the solid interior of the earth when the planet was born. These gases bubble out of the lava when it reaches the earth's surface. All the water in the oceans, lakes, and rivers of the earth is believed to have come out of the interior of the planet in this way, in the form of steam escaping from molten rock. The earth's atmosphere—except for oxygen, which is produced by plants—also seems to have bubbled out of the interior of our planet at some time in the past. The discovery of huge mounds of congealed lava on Mars indicates that there, too, water vapor and other gases were carried upward to the surface by molten rock. Mars may be relatively dry and airless today, but the presence of the Martian volcanoes suggests that at one time its surface could have been partly covered with water and blanketed by a fairly dense atmosphere. No development more encouraging for predictions of Martian life could be imagined.

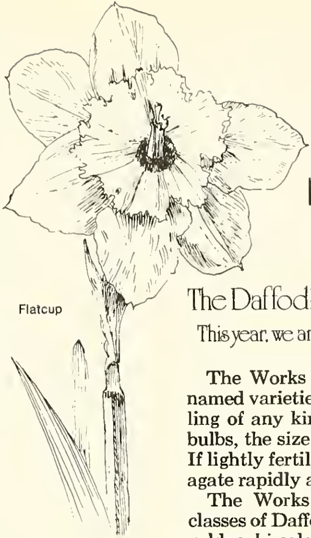
But there was more to come. As photographic coverage from the orbiting Mariner 9 continued, still clearer indications developed that large volumes of water had once coursed across the plains of Mars. One of the strongest items of evidence is a mosaic of three Mariner pictures that reveals a system of braided channels. These are identical to the channels formed by silt-laden rivers on the earth. The silt in such watercourses is deposited on the river bottom, and eventually blocks the flow in the existing channel, forcing the river to create a new channel nearby. After this has happened several times, the old and new channels weave in and out of one another in a braided pattern.

A great Mars canyon known as The Valley of the Mariner (*Valles Marineris*)—3,000 miles long and up to 75 miles across—provides further evidence of former running water on Mars. This canyon has a pattern of branching channels cutting through its rim, which bears a striking resemblance to the pattern of branching tributaries that cuts through the rim of the Grand Canyon. It is difficult to imagine a process that could produce such branching tributaries, either on the earth or Mars, other than the flow of enormous volumes of water. Nothing like this has been found on the moon.

Other theories have been proposed for the tributaries, such as geologic faulting and rounding of the cracks in the surface by wind erosion, but the braided channels are hard to explain without Martian rivers. The consensus is that the surface of Mars once had a substantial amount of water.

These tantalizing suggestions of an earlier and much wetter period in the history of Mars lead to a picture of a Golden Age on that planet, when the Martian climate may have rivaled that on the earth and life forms could have evolved in profusion. If life evolved during that earlier and wetter period, and if the transition to a drier climate occurred slowly enough, Martian life could have adapted progressively, by natural selection, to the gradual onset of severe conditions. The desert rat, which by its own body chemistry produces the water it needs from its food, is a terrestrial example of such an adaptation. The fossil record on earth tells us that a million generations, and a like number of years, probably would be necessary for the evolution of these desiccated organisms. In each generation during that long period, the weakest individuals—those most dependent on a water supply—would be eliminated and the hardiest would remain, propagating their qualities of strength to their descendants. A highly specialized Martian flora and fauna would gradually evolve, well equipped for survival on a nearly waterless and airless planet. Doubtless these Martian organisms would present an unusual appearance by terrestrial standards of beauty: their forms, internal arrangements, and methods of reproduction might seem bizarre; the fundamental differences between plants and animals, as we know them, might be blurred. Nonetheless, there seems no reason to doubt that varied and interesting forms may exist on Mars today *if* the evolution of life has a high probability. One day in 1976, we expect to land an automated laboratory on Mars with instruments designed to test for the presence of life or the remains of life. Then we may find out what that probability is, and know whether or not we are alone in the universe.

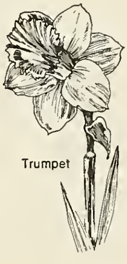
Robert Jastrow, an astrophysicist, is the founder and director of the Goddard Institute for Space Studies in New York City.



Flatcup

Poetaz

Triandrus



Trumpet

The Works

The Daffodil Mixture That Is Really a Mixture

This year, we are happy to say, there is no increase in price.

The Works is unique because it is made only from named varieties, fine ones of recent origin — not a seedling of any kind in the lot. And they are double-nosed bulbs, the size that produce two flowers the first spring. If lightly fertilized after bloom each year, they self-propagate rapidly and reward you with permanent beauty.

The Works is also unique because it contains all classes of Daffodils, except miniatures. There are yellow, golden, bi-color, and pink Trumpets; many kinds of the charming Flatcups; members of the Poetaz group, some of which are doubles; Cyclamineus Hybrids having somewhat shorter stems and smaller flowers; and Triandrus Hybrids with clusters of blooms on each stalk.

Cut the flowers and bring them inside — they'll last from 3 to 5 days. Because The Works has a long season of bloom, you'll have flowers in the house all spring, inexpensive ones you can say.

You wouldn't expect a mixture of named-variety Daffodils, double-nosed, to sell for less than $23.75 a hundred, and it doesn't. But $23.75 is less than the price of other good mixtures. The Works is sold only by the hundred (this is also the thousand rate, so you can easily order any desired quantity). Shipping charges (about 10 to 15 percent) are extra and will appear on your order acknowledgement, but if the bulbs travel far, an additional charge will be made after shipment. We think it only fair to tell you of possible additional costs before buying these heavy bulbs. (Please add sales tax if shipped to a Connecticut address.)

You may order from this advertisement. If charged, please request a credit application form. An order for The Works will bring you an annual subscription to White Flower Farm publications — the Spring and Fall Editions of *The Garden Book,* our catalogue, which is *really* a garden book, and three editions of NOTES, a valuable reminder publication issued Spring, Fall, and Winter. And you will receive these useful gardening publications throughout 1975 — without charge. However, if you want to shop for fine named-variety Daffodils or other spring-flowering bulbs or perennials or unusual shrubs, but not this mixture, send $3.00 for a subscription to the White Flower Farm Publications, which includes a credit for $3.00 on a first $15 order.

But if this mixture interests you, please order it at once, for it sells out every year and cannot be reordered from Holland. Last year we returned orders for more than 30,000 bulbs. That's not a pleasant happening. — A. Pettingill

WHITE FLOWER FARM

Plantsmen

Litchfield 346, Connecticut 06759

The Rise and Fall of Heroin Addiction

A modern-day epidemic affirms some old public health truths

by Robert L. DuPont

A major heroin epidemic is now receding in cities across the United States, leaving in its wake hundreds of thousands of addicts, as well as changed national attitudes toward crime, cities, and race. Since many of these attitudes are badly distorted and could have negative, long-term consequences, it is important to set the record straight on this complex subject.

My experience with the problems of heroin addiction grew out of my work as a psychiatrist with the District of Columbia Department of Corrections in 1967 and 1968. My colleagues and I found that of the 800 men committed to D.C. Jail each month, about half were addicted to heroin; furthermore, addiction was a major cause of the crimes that led to their imprisonment. It was obvious that the prisons and community were offering little help to these people and that massive efforts would have to be made to solve the problem of heroin addiction. One aspect of this new effort was the creation in 1969 of a city treatment program, the Narcotics Treatment Administration (NTA), which I directed from its inception until 1973. During those four years NTA treated more than 15,000 people for heroin addiction.

Analysis of NTA records tells much of the story of the heroin addiction epidemic. Among our findings were that an overwhelming number of the patients were new users of heroin and that nearly two-thirds began use between 1966 and 1970—the epidemic years. Even among those who came into treatment in 1973, few had begun using heroin after 1970. For example, 3,100 patients had started on heroin in 1969, but by 1973 the number had dropped to fewer than 100. At first we thought that new users were simply no longer coming to the center, but as we monitored the data, it became increasingly clear that the lag in seeking treatment accounted for only a small part of the decline.

We also found that heroin addiction in Washington did not occur randomly in the city's population. While it existed in virtually all segments of the population between the ages of ten and seventy, it was highly concentrated among lower-class, black young men.

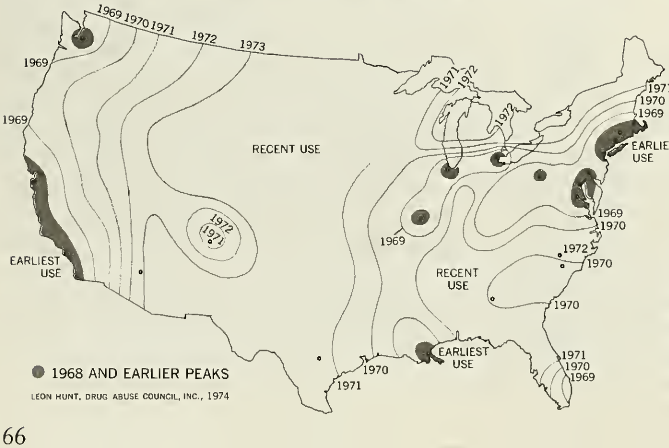
The ethnic and economic composition of the addicted population was not unexpected, but we were surprised to find that more than half the people treated by NTA were born between 1945 and 1954—the years of the post-World War II baby boom. The severity of the epidemic among this relatively small segment of the population can hardly be exaggerated. Of the young men born in 1952—the peak birth year for heroin addicts—fully 20 percent became addicted to heroin and were subsequently cared for by the city's narcotics treatment program.

The attack rate, to use public health terminology, among those living in the poorer sections of the city was double the city-wide rate. For individuals born during the peak years it was more than fifty times greater than the rate for individuals born only ten years before, or a few years after, 1952.

In the last few years public concern has focused on heroin addiction among returning Vietnam veterans and on the spread of heroin addiction out of the ghettos and into the middle-class suburbs, but neither of these developments contributed more than a small fraction to the total addiction problem in Washington.

Another critical finding from the NTA experience was that the use of heroin spread rapidly from one new user to another during the epidemic. As one patient told me, "I began using heroin just like I began smoking cigarettes—right after my best friend started using it, he turned me on to it at a party in his home." Few within the susceptible group were acquainted with long-term addicts, and almost all were convinced that they themselves would not become addicted.

By 1970, however, this attitude had changed, and heroin was no longer regarded as casually as cigarette smoking. The devastating effects were all too clear—deaths due to overdoses and prison terms for using and selling heroin had be-



LEON HUNT, DRUG ABUSE COUNCIL, INC., 1974

The heroin epidemic peaked in most coastal cities by 1968, then moved to less populous areas and inland regions, where addiction rates climaxed as late as 1972–73.

NATURAL HISTORY

This is for me.

○ I want to join The American Museum of Natural History and get 10 lively issues of **Natural History** with my one-year membership.*

○ I want to give **Natural History** and a one-year Associate Membership in the Museum* to somebody else who cares.

○ I want to splurge and do both.

○ I enclose payment ○ Bill me later @ $8 per subscription

*I understand that each membership-subscription includes: free admission to the Museum *plus* two bonus books a year *and* a discount at the Museum Gift Shop.

J123

My Name
Address
City State Zip

○ New subscription ○ I prefer 2 years at $15
○ Renewal ○ 3 years at $21

send gift subscription to:

Name
Address
City State Zip
Sign gift card from

○ I prefer 2 years at $15 ○ 3 years at $21

FIRST CLASS
PERMIT NO. 4946
DES MOINES, IOWA

BUSINESS REPLY MAIL
No Postage Stamp Necessary if Mailed in the United States

POSTAGE WILL BE PAID BY—
NATURAL HISTORY
P. O. Box 5000
Des Moines, Iowa 50306

come almost everyday occurrences.

The heroin scene changed dramatically in Washington as the epidemic peak passed. Overdose deaths, which rose to eighty-two in 1971, fell to seventeen in 1973—and only four of these occurred during the last six months of the year. In early 1972 more than 30 percent of the defendants arraigned in D.C. Superior Court tested positive for heroin. Today that number has fallen to fewer than 10 percent.

The number of patients peaked in July, 1972, when more than 4,700 people were in NTA treatment. By the spring of 1974 this number had fallen to less than 2,000. Significantly, the crime rate in the nation's capital, as in some other cities, has also dropped dramatically.

How can we account for the decline in heroin use? First, the provision of treatment offered an alternative to the pusher's and street addict's life-style, and gave individuals a chance to rebuild their lives. Successful law enforcement efforts to diminish the supply of heroin also made a difference—in less than two years the street price of heroin in Washington rose from about $1.00 a milligram to more than $5.00.

Finally, and perhaps most importantly, among those in the susceptible population there was a growing awareness of the dangers of addiction, leading to the widespread rejection of heroin use. It is one thing to grow up knowing that there is an older fellow on the next block who is addicted to heroin and quite another to have many of your close friends either strung out, in jail, or dead from an overdose. It took several years for the more appalling consequences of heroin addiction to become obvious to susceptible youngsters, but once they were apparent, a cultural immunity developed.

What are the implications for the future? It is obvious that large numbers of people have become seriously addicted to heroin and that some of them will have problems for years to come. Treatment must continue to be available to the addicted. We must intensify efforts to reduce the supply of illicit drugs, just as we must continue to support those forces that reject heroin addiction in the community. Community acceptance of former addicts must be fostered so that we do not make permanent outcasts of thousands of people. Drug abuse trends must be closely monitored to spot potential epidemics early, and when the signs appear, vigorous intervention aimed at reducing the supply of the drug and at reducing the demand for the drug through prevention and treatment must take place before the epidemic rages out of control as it did in the late 1960s.

While we have been talking about the Washington experience, many American cities are now reporting similar, although less steep, downturns in heroin addiction. More remarkable than these downward trends is the realization that almost all American cities had a heroin epidemic at about the same time as Washington. The peak in new heroin use occurred as early as 1967 in some places—notably New York City and Los Angeles—and as late as 1971 in other cities, particularly smaller, inland ones. Thus, there was evidence of spread over time, but the range of epidemic peaks was narrow. Even more striking, epidemic peaks occurred at about the same time in many other countries. Britain, France, Germany, and even Hong Kong, to mention only a few, appear to have had similar epidemics. Cities and countries had vastly different levels of heroin use, but in most cases the number of new users reached a peak within the same period of time.

This similarity in timing is not easy to explain. One is tempted to look for a correlated rise in other social problems, but poverty, crowding, racial prejudice, and unemployment—all possible explanations—did not suddenly peak in the late 1960s. In fact, at that time all these ills were showing modest improvements in Washington, as they were throughout most of the United States.

In part, the spread can be traced to the role of mass communications and mass travel. But it is in the new, epidemiological understanding of heroin addiction that we may find other and probably more revealing clues. Heroin addiction was concentrated among the people

Collectors' Pieces for a Select Few.

Extremely limited, Numbered Issues of 12 figurines in Sterling silver with 22K gold accents. "The Mexican Collection" from Lunt Galleries. Most are scale replicas of famous museum pieces authorized by The Mexican Nat'l Museum of Anthropology.

Full-color catalogue. Send $1.00 to LUNT GALLERIES, Dept. F, Greenfield, Mass. 01301.

THE MEXICAN COLLECTION
LUNT GALLERIES

Lunt Galleries, a division of Lunt Silversmiths.
Shown: Atlante from Tula. Issue 1000.

THE ORIENTAL ART OF BONSAI

BONSAI

IMPORTED FROM JAPAN AND CHINA
FOR HOME, OFFICE OR AS THE PERFECT GIFT IDEA

A LIVING MINIATURE TREE, REFLECTING THE PASSING YEARS IN ITS GNARLED TRUNK AND TWISTED BRANCHES. EACH NEW SEASON BRINGS WITH IT FLOWERS, BERRIES AND CHANGING COLOR. IF YOU CAN WAIT JUST ONE WEEK, WE WILL DELIVER A TREE THAT HAS WAITED ALMOST TWENTY YEARS.

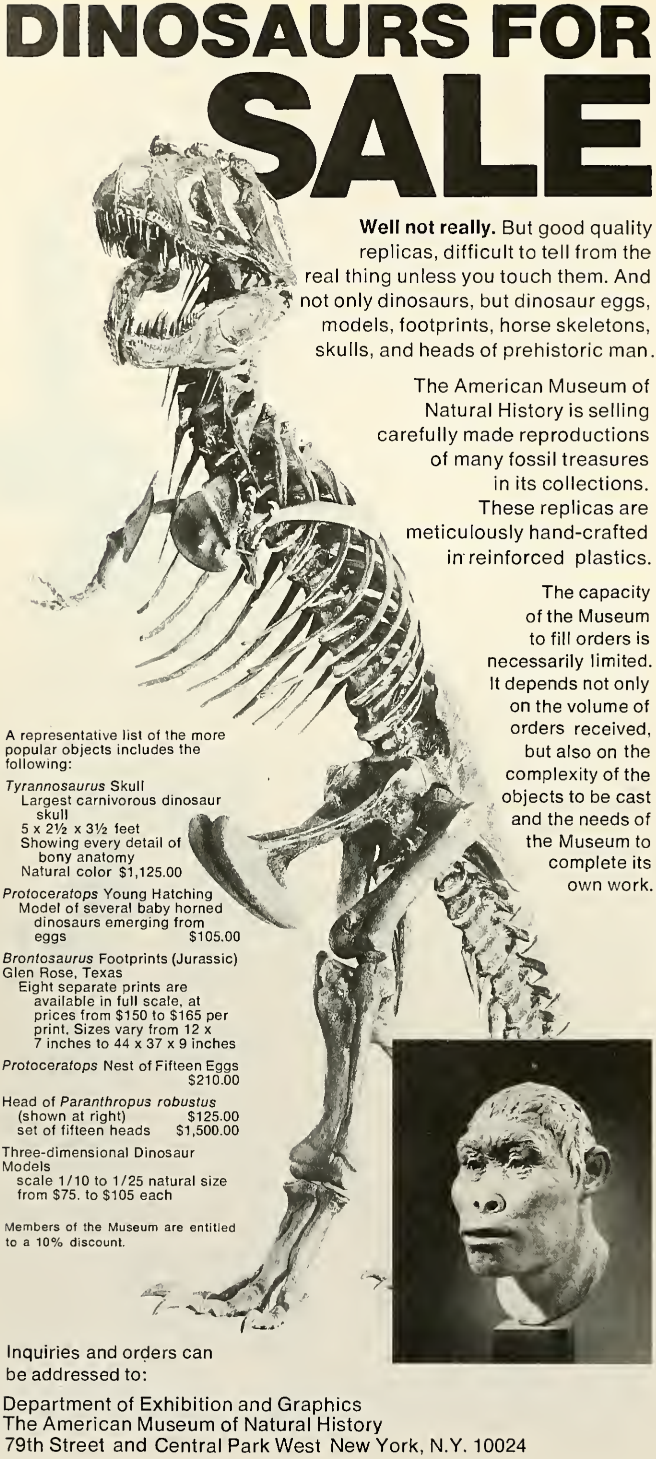
HEIROB BONSAI NURSERY, INC.
Willowemoc Road, Livingston Manor, New York 12758
PHONE ORDERS ACCEPTED (914) 439-5706 NH

Quantity
☐ 12" Japanese Flowering Quince
☐ 8" Blue Moss Cypress
☐ 10" Japanese Cedar
☐ 8" Japanese Elm
☐ 12" Japanese Juniper
☐ 1 Tree... $34.50
☐ 2 Trees.....66.00
☐ 3 Trees......97.00
☐ 4 Trees....125.00
☐ 5 Trees....150.00
☐ Catalogue

Books on Bonsai
☐ Bonsai, Saikei and Bonkei, $9.00
☐ Introductory Bonsai $7.00
☐ Bonsai for Beginners $6.00
☐ 5 Pce Bonsai Tool Kit, $19.95
☐ 6 Pce Deluxe Bonsai Tool Set in Zippered Pouch, $35.00

Prices include delivery anywhere in North America

Enclosed is my check or M.O. for $________ including sales tax where applicable.
Bill my ________ credit card account for the full amount plus tax $ ________
☐☐☐ ☐☐☐ ☐☐☐ ☐ ☐☐☐
Exp. Date ________ MC Interbank # ________
Name ________
Address ________
City ________ State ________
Date ________ Zip ________
Signature ________
Phone ________


DINOSAURS FOR SALE

Well not really. But good quality replicas, difficult to tell from the real thing unless you touch them. And not only dinosaurs, but dinosaur eggs, models, footprints, horse skeletons, skulls, and heads of prehistoric man.

The American Museum of Natural History is selling carefully made reproductions of many fossil treasures in its collections. These replicas are meticulously hand-crafted in reinforced plastics.

The capacity of the Museum to fill orders is necessarily limited. It depends not only on the volume of orders received, but also on the complexity of the objects to be cast and the needs of the Museum to complete its own work.

A representative list of the more popular objects includes the following:

Tyrannosaurus Skull
  Largest carnivorous dinosaur skull
  5 x 2½ x 3½ feet
  Showing every detail of bony anatomy
  Natural color $1,125.00

Protoceratops Young Hatching
  Model of several baby horned dinosaurs emerging from eggs $105.00

Brontosaurus Footprints (Jurassic) Glen Rose, Texas
  Eight separate prints are available in full scale, at prices from $150 to $165 per print. Sizes vary from 12 x 7 inches to 44 x 37 x 9 inches

Protoceratops Nest of Fifteen Eggs $210.00

Head of *Paranthropus robustus*
  (shown at right) $125.00
  set of fifteen heads $1,500.00

Three-dimensional Dinosaur Models
  scale 1/10 to 1/25 natural size
  from $75. to $105 each

Members of the Museum are entitled to a 10% discount.

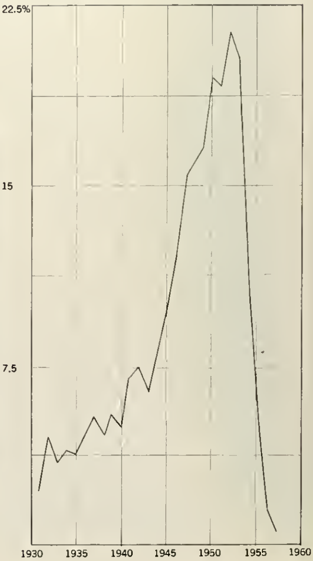
Inquiries and orders can be addressed to:

Department of Exhibition and Graphics
The American Museum of Natural History
79th Street and Central Park West New York, N.Y. 10024

born after World War II. It occurred predominantly among the great bulge in the population, which, by sheer mass action, created the youth culture of the late 1960s. World War II and the subsequent rise in fertility rates were worldwide experiences—as were the youth culture, college demonstrations, and the heroin epidemic. Each of these events was itself serious and complex—I am not arguing that they were trivial or even that they sprang from similar roots. I am, however, arguing that they occurred more or less simultaneously and that changes in the structure of the population contributed to this timing.

One aspect of this epidemiologic approach to the heroin problem deserves special discussion. There are many who feel that it is inappropriate to use the medical model to deal with social processes; that the social and psychological aspects of addiction make it highly unlike the spread of such diseases as tuberculosis and cholera. Although this argument has some appeal, critics of the epidemiological approach ignore one of the most fundamental lessons of public health history: there have been few epidemics that have not disproportionately affected the poor. Social, economic, and cul-

INCIDENCE OF HEROIN ADDICTION BY YEAR OF BIRTH
(Males, Washington, D.C.)



tural factors have played a central role in most epidemics.

In the late nineteenth century, the study of epidemics led to a great debate over their cause and spread. Many claimed that there were no specific causes, but that they reflected over-all social and environmental factors, such as poor climate, crowding, and filth. This became known as the miasma theory. The miasmists called for efforts to clean up cities and reduce crowding. Another group, however, claimed that such illnesses as tuberculosis and epidemic diarrheal diseases were caused by specific germs and spread from person to person. These people emphasized the need for quarantine and treatment. The discovery of bacteria in the late nineteenth century and the development of antibiotics in the twentieth led to the triumph of the germ theory over the miasma.

With a more sophisticated perspective, however, public health scholars have recently reviewed the control of many of these epidemic diseases of the last two hundred years. It is now clear that while the miasmists lost the intellectual argument, their major point has been sustained. Today few would deny that the decline in epidemic infectious diseases was influenced far more by improved economic conditions and the resultant reduction of crowding and malnutrition than by the development of antibiotics and other medical treatments. In fact, medical intervention alone is often ineffective without improved social and environmental conditions.

On the other hand, few patients suffering today from tuberculosis would willingly forego the use of medication. This is similar to the situation with heroin addiction: often, prevention occurs because of changes totally unrelated to the problem itself. The effects of these changes occur over decades and even centuries. But once an epidemic problem is manifest, then every possible intervention, including treatment, is desirable.

If we can get these new facts straight—and our old lessons should help us—we may be able to see the wisdom of the many sides of the emotional debate over the causes and cures of heroin addiction. We may even be able to prevent the occurrence of future heroin addiction epidemics. □

world famed
GOSSEN
Luna-Pro®
SYSTEM CdS REFLECTED
and INCIDENT LIGHT METER

It's every kind of exposure meter you'll ever have to buy!

Just by itself, the Luna-PRO—with its extraordinary 2,000,000:1 sensitivity range—is the world's outstanding meter for reflected and incident light... brightest sunlight... candlelight... even moonlight!

To make it a SPOT METER, ENLARGING METER or MICROSCOPE METER is a matter of seconds with the optional lock-on attachments. The Luna-Pro is the only meter you'll ever have to buy!

SPECIFICATIONS: One-hand operation • Measures reflected and incident light (with built-in hemispheric diffuser) • For still and movie cameras • 30° light acceptance angle • single selector button for high and low range • Automatic "memory" needle lock • ASA 6 to 25,000; f/1 to f/90; 1/4000th sec. to 8 hours; Cine from 8 to 128 fps • EV − 8 to EV+24; .016 to 32,000 foot candles • Weighs only 7 ounces.

OPTIONAL ATTACHMENTS

VARIABLE ANGLE "Spot Meter" ATTACHMENT
MICROSCOPE ATTACHMENT
ENLARGING ATTACHMENT

At better camera stores or write for color brochure
KLING PHOTO COMPANY
P.O. Box 1060, Woodside, N. Y. 11377
DIVISION OF Berkey PHOTO INC

TRAVEL THE WORLD OF LINDBLAD

Lindblad's Japanese Nature Tour
—a seldom encountered, totally different Japan.

Lars-Eric Lindblad's new Japanese Nature Tour was designed to give you an insight to a Japan – far removed from its industrial complexes – a Japan which is still unspoiled by urban population explosion. Much of the flora and fauna you will come upon has been designated as a special national treasure and a great part of the journey will be spent in national parks. You will visit many islands besides Kyushu, Honshu and Hokkaido. In addition to an abundance of bird and animal life you will see spectacular primeval forests, hot springs, Japan's deepest lakes, wild flowers and oriental botanical gardens. You will devote leisure time in fascinating Japanese Inns. This Japanese Nature Tour is indeed an unusual adventure. There will be five tours in 1974, starting May 4. We suggest you write early for our informative color brochure.

LINDBLAD TRAVEL, INC.
Dept. NHA674
133 East 55th Street, New York, N Y 10022
(212) 751-2300

Share the Thrills of Exploring Outer Space!

$219.95 f.o.b. Hartford, Conn.
$15 Crating Charge

All DYNASCOPES, including this superb RV-6, 6-inch available on easy terms!

Now it's easy to join the thousands of serious amateurs who have discovered the excitement of exploring our mysterious universe. Your enjoyment begins right from the start, yet the challenges and rewards go on for years! And it's a hobby that can be shared at modest cost.

Choose From Many DYNASCOPES®

Picking a telescope to fit your needs and your pocketbook is simple when you select a DYNASCOPE—the same instruments used by more than 150 schools, colleges and observatories—and your satisfaction is guaranteed by a full-refund warranty.

FASCINATING GUIDE YOURS FREE!

Read these valuable facts before buying any telescope. Mail coupon or postcard for your complimentary copy of this helpful guide.

Criterion Manufacturing Co.
620 Oakwood Ave., W. Hartford, Conn. 06110

® TM Registered U.S. Pat. Office

CRITERION MANUFACTURING CO., Dept. NH-49
620 Oakwood Ave., W. Hartford, Conn. 06110
Please send your free Telescope Guide.
Name
Address
City State

distinctive
CHRISTMAS IDEAS

A new catalogue of unusual and distinctive presents from the Metropolitan Museum—exact copies of ancient gold jewelry, a silver lotus ladle from the T'ang dynasty, rare early American glass, a Christmas snowflake and star, needlework kits of birds and flowers from the Unicorn tapestries, the Museum's own cookbook, and the 1975 engagement calendar, *Life in America*, are only a few of this year's suggestions. ☆ Also illustrated is a festive selection of more than fifty new Christmas cards. Both presents and cards are made especially for the Museum and can be bought *only* by mail or at the Museum itself. Send the coupon below, together with twenty-five cents for the 100-page color catalogue to be mailed September first.

The Metropolitan Museum of Art
255 Gracie Station, New York 10028

Please send me the Museum's new catalogue of Christmas cards, 25 cents enclosed X1

Name
Address
ZIP

Home Is Where the

SHELTER, edited by Lloyd Kahn. *Shelter Publications/Random House. $6.00; 176 pp., illus.*

How very fine it is to leaf through a 176-page book on architecture—from bailiwicks to zomes—and find no palaces, no pyramids or temples, no cathedrals, skyscrapers, Kremlins, or Pentagons in sight. Nor any Soleri mile-high Arcologiums, Gropius machines for living, Del Webb townhouses, or R. Buckminster Fuller termitoriums. Instead, a book of *homes*, habitations for human beings in all their infinite variety.

Shelter, in the words of the editors, is a book about "simple homes, natural materials, and human resourcefulness. It is about discovery, hard work, the joys of self-sufficiency, and freedom. It is about *shelter*, which is more than a roof overhead." Precisely.

The book begins with a casual survey of home building around the world, now and in the past. There

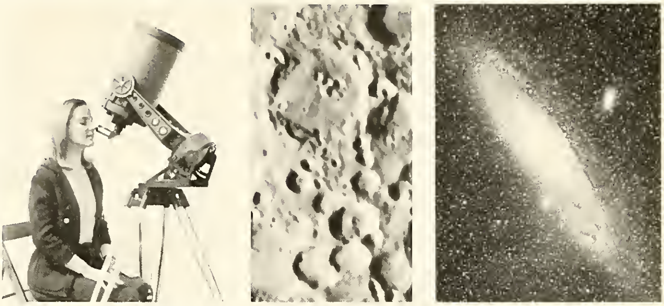
by Edward Abbey

Hearth Is

are drawings and photographs of Mandan earth lodges from the 1830s, the caves at Massafra, ancient troglodyte dwellings in Tunisia, Neolithic caves and house plans, and the homes of Cappadocia in central Turkey, where people even today live in apartments carved out of cones of volcanic tuff.

We are given more pictures of straw huts in Togoland, the strange and beautiful mud villages of the Dogon people (who live along the Niger River near Timbuktu), the

Celestron® Multipurpose TELESCOPES



The Celestron 8, with equatorial wedge and tripod, a portable observatory for the serious amateur astronomer.

Lunar craterlets. A 1-sec. exposure with the Celestron 5 tabletop observatory.

Dust lanes in the Andromeda Galaxy. An 8-min. exposure with the Celestron 8-inch, f/1.5 Schmidt Camera.

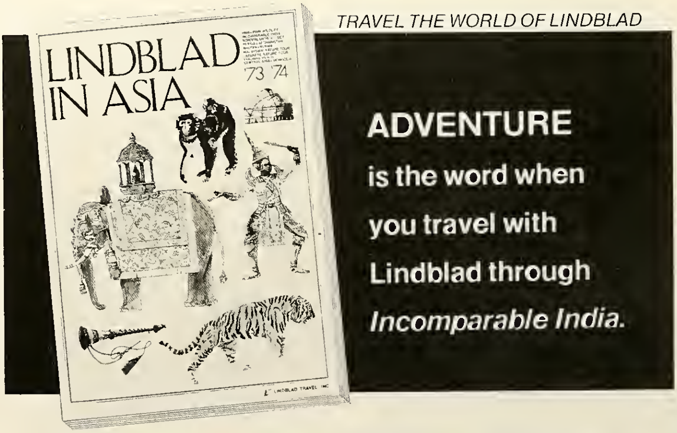
Large observatory telescopes optically folded into compact portables. Razor-sharp Schmidt-Cassegrain optics. These telescopes really make high power worth using! Perfect for serious amateur astronomers, nature observers, educators. Ideal for field trips in astronomy, biology, geology, archeology, architecture and ecology.

Celestron 5. A 12-lb. tabletop observatory, bannister telescope. Observe or photograph moon, planets, nebulae. Inspect the wing feathers of a blue jay at 1,000 ft. (Base Price: $625) **Celestron 8.** Portable observatory for examining the polar caps of Mars, ever-changing belt structure of Jupiter, stellar spectra, filamentary detail of deep-sky nebulae at up to 500X. Also, the ultimate telephoto lens! ($895) Celestron 14. World's largest one-man-portable observatory scope! Reveals numerous subdivisions in Saturn's rings, dust lanes in remote spiral galaxies, yet easily fits into your compact car. ($3 600) Also available: Schmidt Cameras — 14-in., f/1.7 ($3,000); 8-in., f/1.5 ($710); 5½-in., f/1.65 ($565) . . . Cold Cameras . . . Complete astrophotographic labs.

WRITE FOR YOUR FREE COLOR CATALOG

CELESTRON	5″	8″	14″
Useful powers	25-300X	50-500X	50-850X
Light grasp (vs. eye)	188X	510X	1,760X
Photographic speed	f/10	f/10	f/11
Resolution (arc-secs.)	0.8	0.5	0.28
Weight (lbs.)	12	23	108

Celestron Pacific 2835 Columbia / Box 3578-NH / Torrance, CA 90503



One of Lindblad's great Asian Safaris

Rudyard Kipling comes to life in Lars-Eric Lindblad's exciting new 24-day tour through ancient India. You will see tigers from elephant back in Kahana and you will be guests of the Royal Family of Jaipur at their lodge. Your camera will be constantly at work while visiting spectacular temples and historic shrines. An excursion on the sacred Ganges will reveal strange religious rites as they were performed thousands of years ago. You will see the snow-capped Himalayas to the north. Across the border you will find the remote kingdom of Sikkim with the world-famous Tibetan Lama Monestary. Write for our "Lindblad in Asia" brochure which also includes these tours: **Himalayan Wildlife, Borderlands of Tibet, Persia & Afghanistan, Malaysian Nature Tour, Japanese Nature Tour and Explorers' Tour to Central Asia & Mongolia.**

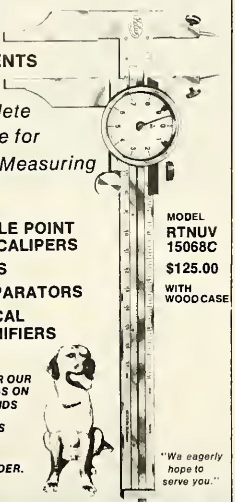
LINDBLAD TRAVEL, INC.
Dept. NHA 674 (212) 751-2300
133 East 55th Street, New York, N.Y. 10022

FOR THE **ZOOLOGIST**
MAMMOLOGIST
BIOLOGIST

J&S PRECISION SCIENTIFIC MEASURING INSTRUMENT Co.

PRESENTS

Your Complete Source for Metric Measuring Tools



- **NEEDLE POINT DIAL CALIPERS**
- **RULES**
- **COMPARATORS**
- **OPTICAL MAGNIFIERS**

SEND FOR OUR CATALOGS ON THOUSANDS OF TOOL BARGAINS —$1.00. FREE WITH ORDER.

1020 East 54th Street, Brooklyn, N.Y. 11234
TEL.: (212) 241-7484

From
The Horchow
Collection

CAPTURE A BATTERSEA BUTTERFLY
Made for us exclusively in England by Battersea and Bilston, this beautiful enameled copper box is topped with a single butterfly, and colored apricot below. 1¾" diameter.
#2685A 25.00 (1.25 postage and handling).
THE HORCHOW COLLECTION
P.O. BOX 34257, DEPT. #01962
DALLAS, TEXAS 75234
☐ Please send the new Horchow Collection Catalogue.

mud and dung huts of the Masai, a reconstructed Iron Age hut of stone and thatch in England. Nomadic homes: the tents of the North African Berbers, the Tuaregs, the Bedouin, the Tekna of Morocco, the yurts of Mongolia, Sioux tepees. Descriptions of Navajo hogans, Hopi kivas, Pima adobe huts. The peasant cottages of England, Yugoslavia, Japan, Norway, eastern Europe, and Russia. Back to the New World—the sturdy timber frame houses of early New England, log cabins, the sod and baled-hay houses of the plains, the early stud frame buildings that made possible the quick towns and cities that followed the white man's "conquest" of the West. Exactly.

Shelter follows the format of the popular *Whole Earth Catalog*. Like the latter, it is about two-thirds illustration; its principle of organization anarchic. Every big page holds photographs and sketches from many sources, as well as quotes, excerpts, captions, stories, Indian legends, anecdotes, and reports—signed and unsigned—from a multitude of voluntary and involuntary contributors. If you try to read this book through from beginning to end you'll likely get bogged down where I did, about page 18, in the middle of the Miwok assembly house or the Wichita grass shack. No matter. Like the *Catalog*, *Shelter* is meant for browsing through, not reading, and one can begin as well in the middle or start at the end and work backward, it makes no difference.

Not a history, not a comprehensive survey, not a study, *Shelter* is a sort of handbook, manual, or guidebook for those who are contemplating the awful prospect of buying title to a piece of the earth's surface and actually building with their own hands and tools some kind of habitable structure thereon. Something I myself, for example, have been planning to do for twenty years; I keep finding good excuses for putting it off till next year. Yet building your own home, however humble, is something that many of us feel we must attempt, sooner or later. Like falling in love, like raising a baby, like a few nights in the county jail, the construction of a shelter is an experience that has to be known if one is to live a complete and adequate life.

Furthermore, as the editors of this compendium point out, the rising cost of materials and labor, the competition for dwindling resources, the pestilential overcrowding of our shrinking planet mean that only the rich or the independent are likely to survive the bleak prospects of the next fifty years. We may be required, ready or not, to scrounge for sticks and stones, find help and friends, make not more with less, but *make do* with less in order to give ourselves and our children a chance to carry on.

Shelter provides helpful hints, although hardly blueprinted instructions, toward survival with honor. I said that this book's principle of organization is anarchic. True. But "anarchic" meaning, not "no rule," but self rule—rule from within, not without. So, in meandering fashion, *Shelter* goes on from the round-the-world overview into sections on building techniques, materials, nomadic living, domes, zomes and zarches, designer-builders, the necessary eco-logic of living with one's immediate environment, energy, wind power, solar heating, water saving, and sewage recycling.

The chapter on domes is called "Domebook 3," after previous publications on this subject by Lloyd Kahn and his friends. Here I was pleased to see a healthy reaction against the dome mania taking place within the same group that formerly promoted geodetics as a metaphysical solution to the housing problem. For years I have been conducting a one-man campaign against that old crackpot R. Buckminster Fuller and all his works. He has ignored my attacks, vicious and scurrilous though they are, feigning unawareness of my existence. But now I have company and we're going to nail him.

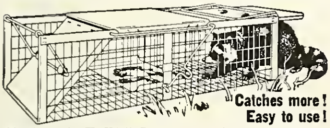
My objection to geodesic dome homes is quite simple: anything that ugly must be wrong. It offends me to see those fungoid warts, those giant sunken golf balls, those polyurethane pustules breaking out like pimples across the face of the splendid American Southwest. To me they are both symbol and symptom of the Plastic Plague, the Age of Junk; their proliferation is an insult to the eye, the mind, and the heart. Why, I wondered, in a land so rich in rock and adobe and cow dung,

Fossils
Shells
Minerals
Indian
Artifacts

SHELLS MINERALS FOSSILS
INDIAN ARTIFACTS
Send 50¢ for Illustrated Catalog
DOVER SCIENTIFIC
Box 6011 C Long Island City, N.Y. 11106

STRANGE ARTIFACTS
A SOURCEBOOK ON ANCIENT MAN
Compiled by WILLIAM R. CORLISS
Over 100 articles on Stonehenge, Scottish Fused Forts, Phoenicians in America, ancient Arizona canals, and other mysterious artifacts as originally printed in *Nature, Archaeologia* and other publications. Thorough index.
262 pages, hard covers, $6 95 postpaid
Published by
WILLIAM R. CORLISS
BOX 107A, GLEN ARM, MARYLAND 21067

CATCH ANIMAL RAIDERS!



Catches more!
Easy to use!
Simple, safe HAVAHART traps catch raiding rabbits, coons, squirrels, pigeons, sparrows, etc., without injury. Straying pets, poultry released unhurt. No jaws or springs to break. Galvanized; many in use 20 years. Open ends give animal confidence. Sizes for all needs. Write for valuable illustrated guide and price list.
HAVAHART, 158 Water St., Ossining, N. Y. 10562
Please send new guide and price list.
Name________________________
Address____________________ Zip______

SUMMER IN THE
WILDERNESS
Climb Adirondack and Big Horn High Peaks.
Canoe voyageur routes in Northern Ontario.
Basic and Advanced Survival Instruction.
Month long Wilderness Expeditions.
Also Weekend/*Custom*Trips: Fall, Winter, Spring
Write for definitive brochure H:
North American Wilderness Survival School
205 Lorraine Avenue, Upper Montclair,
N.J. 07043 Tel: 201-783-7711

NATURE ON STAMPS
The BIRDS & the BEES & the ANIMAL KINGDOM on GENUINE POSTAGE STAMPS.
* SAMPLES & APPROVALS – $1
Satisfaction Guaranteed
Mil Med Stamps
P.O. BOX 297-NH AURORA, CO. 80010

with well-timbered mountains on every horizon, should anyone feel justified in erecting Tinker-toy bubbles coated with poisonous plastic? The answer is, they were cheap, quick, and easy to build, like the tract homes of the mass-housing industry. More important, they were for a time fashionable, like Hindu gurus, hobbits, Janis Joplin, Marshall McLuhan, dayglo wall posters, prefaded Levis, and all the other ephemera of Pop Kulchur.

Now we see objections to the geodesic dome home arising from sources more technical and authoritative than the esthetic-intuitive. The dome leaks; it is not easily salvageable; it is impossible to add on to; it is difficult to square with furnishings inside or to divide into rooms; it requires many small parts and precise technical skill to assemble; the curving surfaces accumulate dust and dirt; the polyurethane covering does not weather well, burns explosively if overheated, releasing cyanide gas, and requires the use of nonrenewable resources such as coal and petroleum in its manufacture. Most important, the dome home is ugly. Fuller's followers will have to look elsewhere to put the master's visions into 3-D reality; perhaps they can revive his Dymaxion car, which lapsed into oblivion at about the same time as the Hupmobile and the Hudson Terraplane and the Airflow Chrysler.

Let's give poor old Bucky a break now and conclude this review: *Shelter* is not a book, although made of paper and print. I don't know what it is. But whatever, it's full of interesting information, useful pictures, fascinating trivia, good ideas, and pertinent quotations from important nineteenth-century American Indian speeches. *Shelter* deserves a place in every home, of whatever conformation, alongside the Bible, the Book of Mormon, Shakespeare, the *I-Ching, The Anatomy of Melancholy, Naked Massage,* the *Old Farmer's Almanac,* and of course, *The Monkey Wrench Gang: A Novel About the Wooden Shoe Business in America.*

Edward Abbey lives on a wildlife refuge in Arizona. He is the author of a forthcoming book, The Monkey Wrench Gang: A Novel About the Wooden Shoe Business in America.

Discover Galapagos
For the discriminating traveler the only way to see the unique Galapagos Islands is on our leisurely two-week cruises in the twelve passenger schooner Golden Cachalot* with its dedicated British crew of eight, including a naturalist leader.
These superb cruises operate all year round, and departure dates are scheduled until the end of 1975.
For budget-minded travelers who are interested in ecology, wildlife and photography, we are repeating our extremely popular GALAPAGOS ISLANDS THRIFT CRUISE in the privately chartered 68-passenger mv Iguana*:
May 30 to June 13, 1975
accompanied by Mrs. Eileen K. Schofield
Herbarium Specialist at the New York Botanical Gardens
July 11 to 25, 1975
accompanied by Mr. Belton P. Mouras
President of the Animal Protection Institute of America
Brochures on all programs are available from:
HANNS EBENSTEN TRAVEL, INC
55 WEST 42 STREET, NEW YORK, NY 10036
TELEPHONE (212) 354 6634
* both ships are registered in Ecuador

actual
size

oneness
A subtle linking of man's religious symbols, delicately wedded together by the artisan.
With illustrated descriptive booklet.
14K with 24" chain $37.50
Sterling Silver $16.75
ISAAC SOLTES DESIGN NH
1923 S. McPherrin Ave.
Monterey Park, Calif. 91754
Check or Money Order / Money-back Guarantee

JEWELRY LIFE SIZE
BC-8 Byzantine Cross
EY-1 Sacred Eye Ring (Ancient Egyptian Doctor's Amulet)
AP-5 ANKH PENDANT 2½" long

Ancient Jewelry Replicas
In 14 Karat Gold & Sterling Silver

		Sterling Silver	14K. Gold
AP-5	Ankh Pendant 24" ch.	$27.00	$39.00
BC-8	Byzantine Cr. 24" ch.	29.50	95.00
EY-1	Sacred Eye Ring	25.00	89.00

Rings sized to 11½ no extra cost. • Money back guarantee. Add $1.50 for insured postage. • Orders shipped promptly. • Bankamericard & M.C. for orders $50. minimum.

NOTICE: These Jewelry Prices from 1973 will increase in August 1974. Send your order today end save!
VISIT GALLERY—APPT. ONLY—CALL CI 6 0793
aladdin house, ltd.
Dept. NJ674 • 648 Ninth Ave. • N.Y. 10036

YOU *SEE* MORE
WITH QUESTAR

A stunning composition photographed by Questar without tower or stalking blind; just the 500 feet between Questar (in cover shot) and water turkey kept this nervous bird sitting quietly on his perch for the picture. Part of the print cropped off for this space actually showed a cobweb holding captured insects. Tri-X, 1/250 second.

Questar's new Fast Focus makes wildlife shots easier than ever, and the Carpod lets you, too, sit quietly while you take pictures like this from inside your car.

For a complete description of photo-visual Questar, the world's finest, most versatile telescope, send for our booklet of photographs by Questar owners; $1 for mailing on this continent; by air to S.A., $2.50; Europe and N. Africa, $3; other areas, $3.50. QUESTAR'S Florida showroom is at Q Camera in the Daytona Beach Mall.

© 1974 Questar Corporation

QUESTAR

Box T60, New Hope, Pa. 18938

Announcements

GAIL HANSBERRY

Children of Africa . . . On June 28 the Education Gallery will open a new exhibit of photographs and slides showing children of African descent not only in Africa but in the United States, South America, and the Caribbean.

A New Display in the Museum showcase at the Roosevelt Rotunda, features a "Preview of the New Hall of Minerals and Gems," and highlights some features of our Mineralogy Department. An amythest display demonstrates the wide variety possible in the occurrence and appearance of a single mineral. Another part of the exhibit deals with some uses of minerals—in this instance as carvings or gemstones.

Continuing Exhibits . . . "Window to the Sea," the special exhibit of the Lerner Marine Laboratory, will be on view through July.

The Alexander M. White Natural Science Center is now in full swing, and visitors—particularly young ones—may enjoy its exhibits of the urban environment at these times:

Tuesday—Friday: 1:30–3:30 P.M.
Saturday: 12:00–4:30 P.M.
Sunday: 1:30–4:30 P.M.

Planetarium Sky Show . . . "Jupiter Journey," ends July 1. A new show, "Signs in the Sky," begins on July 2. This show looks at some popular notions of astrology to see if they have any basis in science. The origin of the Zodiac and of astrology itself will be discussed. "Signs in the Sky" will be shown through September 16. Admission—which includes admission to the Museum—is $1.75 ($.90 for children and $1.25 for senior citizens), and shows are scheduled for 2:00 P.M. and 3:30 P.M. on weekdays, with more frequent showings on weekends.

Gallery 77's July exhibit will feature the scanning electron microscope.

Museum Tours . . . Late in May, 150 travelers—members of the Museum and their families—cruised the Adriatic, Ionian, and Aegean seas. The group studied the cultural anthropology and archeology of the area and also learned the principles of celestial navigation from Dr. Thomas D. Nicholson, director of the Museum.

A second, much smaller group will visit five of the nations of southern Africa in September, under the guidance of Dr. Richard G. Van Gelder, curator of mammalogy and an expert on the nyala antelope of Mozambique. These Museum trips have received such an enthusiastic response (the African trip has been sold out for some time) that an 18-month program is now being planned. Announcements will be mailed in mid-summer. Please write Mrs. Marie Caufield at the Museum if you would like advance notice.

let's make a deal!

A remarkable offer from one of America's largest Film Processors.

Kodak
Kodacolor II
COLOR NEGATIVE FILM
110 CARTRIDGE
FOR COLOR
C 110-12
Atlas Rand

Join the "FUN SHOOTERS"

Takes beautiful color prints or slides and black & white prints . . . indoors and outdoors . . . day and night.

You'll like this camera! We'd like your film processing business...so
we'll send you this $25 value Instant Loading Pocket Camera Kit for only....... $12^90

and you send us the first 4 cartridges of film you shoot with it, which we'll process at our regular price of just $3.45 per cartridge. (The $3.45 includes Processing, 12 Borderless fine quality Silk Prints, and a **fresh Kodacolor Film Cartridge.**

Fits in pocket.

Instant loading.

Aim and shoot.

Amazing New Type of Camera

- Instant cartridge film load. No fumbling. No mistakes.
- Only 5″x2″x1″. Fits in pocket or purse.
- Uses new Kodak 110 film to give big 3½″x4½″ color or black and white prints, and sharp 30x 30mm mounted color slides.
- Always in focus—from 5 feet to infinity—without turning any dials.
- Flashes without batteries . . . has thumb film advance with double exposure prevention . . . color correct f9.5 lens with sliding lens cover.
- **Kit includes:** Pocket-Matic Camera. 4-shot Magicube (flashes without batteries, rotates automatically as film is advanced), and Kodak 12-exposure 110 (pocket size) colorprint film.

As a "Fun Shooter" you will receive:

- COLOR FILM! You get a fresh cartridge of Kodak color film with every cartridge you send to us for processing.
- BIG SAVINGS! On 12 colorprints, black and white prints, color slides, film, processing, cameras and photographic equipment.
- PREFERRED SERVICE. Fast, superior quality. Over 12 million rolls of films are developed each year with care and dependability. Borderless textured color prints with 20% larger picture area. Deluxe rounded corners, silk finish. Fingerprint-proof surface.

We're so sure that after using our service just 4 times, you'll be so delighted with us, you'll continue as our customer again and again.

Mail this coupon today!

SATISFACTION GUARANTEED. If not 100% satisfied return the camera kit within 30 days and owe nothing.

ATLAS RAND
Kalisa Way, P.O. Box 762, Paramus, New Jersey 07652.

☐ YES, sounds like a good deal to me. Send me the $25.00 Atlas Rand Pocket-Matic Camera Kit for just $12.90, postpaid. I agree to send the first four colorprint film cartridges I shoot with this camera to you for processing at your regular price of just $3.45 per cartridge. For each film I send, I will receive back my prints PLUS ONE FRESH CARTRIDGE of Kodak colorprint film. There is no time limit, and I have no further obligations.

☐ Check or money order for $12.90 enclosed. (N.J. residents send $13.55).

☐ Charge $12.90 (N.J. residents $13.55) to my credit card account:

No.____________________ Expiration date________

☐ American Express ☐ Master Charge
☐ BankAmericard
☐ Diners Club ☐☐☐☐ Enter 4 digits above name on Master Charge

Name____________________
Please Print First Middle Last

Address____________________

City__________ State__________ Zip__________

Signature____________________

Telephone (Area Code)__________(No.)__________

All orders are subject to credit approval. Prices and terms may be changed without notice. This offer may be withdrawn at any time.

501A

The Turn of the Ewe

Custom may keep women in the kitchen, but what primeval force drives men to the barbecue pit?

Gentlemen, don your aprons. The season for outdoor cooking is upon us. Let the women marvel at our prowess with massive cuts of meat and charcoal fires in the open air. They have had all winter to press the claims of indoor kitchen food, through artful and civilized ceremonies of stewing dainty cubes or roasting a joint in the engineered dry heat of closed ovens. Now it is our turn to perform the manly rite of the barbecue.

The tradition stretches back as far as the Trojan War, when, to propitiate Apollo,

> The limbs they sever from th'enclosing hide;
> The thighs, selected to the Gods, divide:
> On these, in double cauls involv'd with art,
> The choicest morsels lay from every part.
> The priest himself before his altar stands,
> And burns the off'ring with his holy hands,
> Pours the black wine, and sees the flames aspire;
> The youths with instruments surround the fire:
> The thighs thus sacrificed and entrails drest,
> Th'assistants part, transfix, and roast the rest.
> *The Iliad, bk. I, l. 602*

Centuries later, according to the evidence of a Renaissance manuscript, Hungarian villagers would celebrate an important wedding by spitting an entire 2,000-pound ox stuffed with a calf stuffed with a lamb stuffed with a capon stuffed with a quail. Men took care of all stages of this mammoth enterprise.

Their contemporary, Leonardo da Vinci, has left us his designs for spitting mechanisms. And Sardinian peasants to this day feast on accarrexiau, a sheep stuffed with a suckling pig and roasted over embers out of doors.

Farther south, in Muslim Africa, the méchoui (spitted lamb) is the leading form of banquet. My sister and her husband rode into an animistic Sara village in Chad on assignment for the Peace Corps in the late sixties. The chief put on his best méchoui for their delectation: a lean billy goat slaughtered, sewed up with number 12 uninsulated wire, and basted with hot sauce over a hardwood fire. A village elder took the testicles home with him (for sympathetic magic?).

The méchoui was long ago exported north to France from Morocco and Algeria. And a group of French chefs established the custom on American soil a year ago during a weekend in Hunter, New York.

Spit roasting is not, however, a new arrival in the New World. Electrified versions of Leonardo's clockwork device, which speckle our suburban landscape, testify to the survival of the spit in America. If we regard spit roasting as only the most exalted form of barbecue, we live in the world center of the oldest method of meat cookery.

The word *barbecue* is totally American. One etymology, probably false, interprets the term as a corruption of the French *de barbe en queue*. No doubt, early French settlers did grill whole goats, from beard to tail. But the likeliest origin of barbecue is *barbacaa*, a Spanish-Indian word for a grid of green boughs laid over a fire.

At any rate, barbecue is the epitome of American food. Lyndon Johnson astutely (he was notably uneasy with the White House French cuisine) held a classic American barbecue by the banks of the Pedernales, a state barbecue, mind you, for members of the German government. This struck many admirers of President Kennedy as unbearably infra dig, something their more cultured and Francophile hero would never have stooped to.

Perhaps not, but the masters of French cuisine have always taken it as an axiom that the best way by far to roast meat was on a spit over, or next to, a wood fire. "Those who cook game in the oven or on a rotisserie," wrote Lucien Tendret, the gastronomic theorist, "give proof of their ignorance and bad taste; in general, they assume any butter is fresh that hasn't melted and they see no difference between today's egg and yesterday's." Tendret thought he was following his master, Brillat-Savarin, in calling roasting (on a spit) the most exquisitely difficult discipline in all cookery.

Brillat-Savarin wrote, cryptically: "Men learn to cook, but they are born knowing how to roast." In other words, roasting is an art, not a science. But, since for Tendret, roasting was preeminently a science learned with much care, he emended the aphorism to read: "Men learn to roast, but they are born knowing how to cook."

I bring all this up because it bears directly on the cultural meaning of barbecue.

Barbecue—open-air roasting—is, whether done on a grill, on a spit, or in a pit, the fundamental type of meat cookery. There is no question that when meat was first cooked, it was roasted. There can be little doubt that all cooking began with this process. And even if this were historically untrue, even if an archeologist someday proves that cooking began with fried potatoes, it will not alter the conviction shared by oil-rich sheiks, San Antonio accountants, and seminomadic Amazon tribesmen that the primeval food of humans is a hunk of red meat roasted outdoors.

In other words, the natural form

STEVE MYERS

Cornell University Press

The Mound People

Danish Bronze-Age Man Preserved

By P. V. GLOB. Combining his usual flair for anecdote with impeccable archaeological detail, Mr. Glob describes the many treasures that have been discovered under the 3,000-year-old burial mounds that dominate the Danish landscape. His entertaining account of the excavations and the sophisticated society they revealed is strikingly illustrated with photographs, drawings, and a map.
$12.50

Also by P. V. GLOB

The Bog People

Iron-Age Man Preserved

"It is impossible to put down.... It is superbly illustrated with 79 photographs of the bodies, apparel, and bogs where the corpses were uncovered."
$10.00 —*Mankind*

Peyote Hunt

The Sacred Journey of the Huichol Indians

By BARBARA G. MYERHOFF. The intriguing culture of the Huichols is captured in this handsomely illustrated book. The high point is a vivid first-hand account of an annual peyote pilgrimage that holds the key to the meaning and richness of the Huichol's world.
$15.00

CORNELL UNIVERSITY PRESS NH
124 Roberts Place
Ithaca, N.Y. 14850
Please send me at once, postpaid, the books I have indicated.
☐ The Mound People @ $12.50
☐ The Bog People @ $10.00
☐ Peyote Hunt @ $15.00
I enclose $________
Name ________
Address ________
City ____ State ____ Zip ____
(N.Y. residents add sales tax.)

of cooking, the method that goes back to the days before agriculture and permanent houses (with women installed in their kitchens) is barbecue. Boiling, on the other hand, is the paradigm of cultural cooking in pots and produces the food of the settled, feminized life. As Professor Lévi-Strauss would put it, indeed as he does put it, in *L'Origine des manières de table*, roasting is to nature as boiling is to culture.

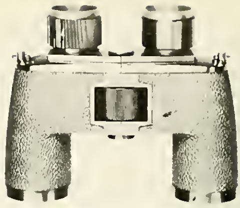
This helps to account for the American male's ebullient sense of returning to his frontier prerogatives when he plunks a steak on his grill. It also elucidates Brillat-Savarin, who, it is clear, should be paraphrased: cooking must be learned like other cultural activities; roasting is a natural talent we are born with.

Barbecue, then, is at once the most primitive and the most delicious way to cook large cuts of meat. Ovens be damned with their desiccating heat. Down with indoor gas and electric grills that don't sear fast enough or add flavor like natural fires. Step outdoors with Brillat-Savarin, LBJ, and the rest of the guys. Ladies welcome too.

Méchoui

1 leg of lamb with extraneous fat removed
1 tablespoon ground coriander seed
4 cloves garlic, peeled and mashed
1½ teaspoons ground cumin
¾ teaspoon sweet paprika
4 tablespoons unsalted butter, softened
Salt to taste
Oil

1. Prepare a fire, with hardwood or charcoal. When the initial flames have subsided somewhat or the coals have turned white, you have reached the optimum heat for slow cooking. Test your electric spit to make sure it is strong enough to support and turn the lamb. If it isn't or if you have no spit, you can improvise one using a 3-foot-long, ¼-inch-square steel rod (available at most hardware stores) and two shish kebab skewers. Drill a hole at each end of the rod, allowing enough space to center the lamb between them. Push the rod through the lamb as close to its center of gravity as possible. Then insert the two skewers into the lamb parallel to



BUSHNELL 7x35 CUSTOM
Mfg. List $139.50 Postpaid $84.50

This is an example of the deep discount prices on high quality optics that is found in our FREE catalog. This catalog lists and illustrates an outstanding selection of camera lens, telephoto lens, telescopes, binoculars etc., plus valuable information on how to properly select them. Write for it today.

GIL HEBARD OPTICS
COURTHOUSE SQ., KNOXVILLE, ILL. 61448

FIFTY JUNGLE BUTTERFLIES $2.95
THIRTY EXOTIC SEASHELLS $1.95
FIFTEEN BEETLES—WORLDWIDE $3.25
EIGHTEEN GEM-STONES $2.25

PLUS giant Natural Hobbies Bargain List with many school projects and gift suggestions.
Dept.H,Collectors'Wonderland-Box 1170,N.Y.10008

BOOK HUNTING?

Virtually any book located—no matter how old or long out-of-print. Fiction, nonfiction. All authors, subjects. Name the book—we'll find it! (Title alone is sufficient.) Inquire, please. Write: Dept. 65.
BOOKS-ON-FILE
UNION CITY, NEW JERSEY 07087

BETWEEN LAND AND WATER

The Subsistence Ecology of The Miskito Indians, Eastern Nicaragua

by BERNARD NIETSCHMANN

A detailed analysis of the organization and ecological system of the Miskito Indians—one of the last remaining societies based on the economic staples of hunting and fishing. After measuring the Miskito's labor inputs; agricultural, hunting, and fishing yields; and food distribution over a one year period, the author found the traditional Miskito economy to be a highly productive system — one that fosters adaptation to a complex and varied environment without creating excessive demands on it. He goes on to show how this subsistence system is being destroyed by the demands of foreign markets which have led the Miskito to exploit their fish and game population and an effort to participate in an extraneous, monetary-based market system. *1973, 288 pp., $11.95/£5.75*

ACADEMIC PRESS, INC.
A Subsidiary of Harcourt Brace Jovanovich, Publishers
111 FIFTH AVENUE
NEW YORK, NEW YORK 10003
24-28 OVAL RD., LONDON NW1 7DX

the rod. Start one at one end of the lamb and the other from the other end. You should end up with one skewer on either side of the rod. Now pass a few inches of uninsulated wire through each hole in the rod and twist tightly around the handles of the skewers. This jerry-rigged spit, easier to construct than it may sound, will keep the lamb from spinning around the rod as it turns.

2. Make deep incisions in the fleshy portion of the leg. Blend all other ingredients into a paste and rub into the meat. Let stand 10 minutes.
3. Set the spitted leg over the fire. Rest the ends of the spit on bricks on either side of the fire so that the meat hangs down over the fire but not in it. Turn slowly for three hours or until the meat can be pulled away easily with the fingers. Brush oil on the meat every ten minutes or so. Be sparing because dripping oil will make the fire flame up and you will then have to douse the fire after each basting. The best possible basting liquid would be a liquefied version of the paste applied to the meat. Prepare the same quantity as before and keep it liquid by the side of the fire.

The lamb will emerge from all this seared and brown outside and juicy but not pink within. The idea for this adaptation of a Berber recipe comes from Paula Wolfert's *Couscous and Other Good Food from Morocco* (Harper & Row, $10.95). For complete authenticity, eat the lamb sizzling from the fire, with your fingers (right hand only, please).

NOTE: If you do not want to bother spitting the lamb, you can approximate the results of this recipe by barbecuing in the conventional manner and turning the meat frequently. This is not, however, sporting, nor will you win a medal from the Explorers' Club if you do the lamb in the oven. (Start at 475°F., fatty side up, on a rack in a roasting pan for 15 minutes; then continue at 350° for 2 hours and 45 minutes, basting every 15 minutes with pan juices.)

Raymond Sokolov is a food columnist and editor of Great Recipes from the New York Times.

Nikon wants you to see better

Nikon prism binoculars start with world-famous Nikon optics, made from Nikon optical glass. Lenses and prisms for right and left barrels are precisely matched and collimated, and the optical parallelism of both barrels is verified.

That's why with Nikon binoculars you enjoy brilliant, sharp, full-field viewing without strain or fatigue, even for long stretches. Now, find out how little more it costs to see better, longer. At Nikon camera dealers and selected optical departments. Write for literature Folio 18, Nikon Inc., Garden City, N.Y. 11530. Subsidiary/Ehrenreich Photo-Optical Industries, Inc. (In Canada: Anglophoto Ltd., P.Q.)

Nikon Binoculars

TRAVEL THE WORLD OF LINDBLAD

Short of the moon—this is as far as you will travel on earth!

ANTARCTICA

For the tenth consecutive year, Lars-Eric Lindblad invites you to see this last frontier on our shrinking planet. Our decade of travel to the south polar regions has given us a body of experience no one else can even approach. You will experience the thrill of treading on land which until recently was reserved only for explorers. Four expeditions starting at the end of this year will feature the Falkland Islands as well as Antarctica. In addition, the first will also include the South Georgia Islands—the famed whaling stations of years past.

The MS Lindblad Explorer* operated in the great tradition of the Swedish American Line, will provide all the comforts you can ask for. Because of the immense popularity of these expeditions, we suggest you make your reservations early. Please write for our Antarctica brochure only if you are seriously interested.

LINDBLAD TRAVEL, INC.
Dept. NH AN 674
133 East 55th Street, New York, N Y 10022
(212) 751-2300

*Panamanian registry

LIVE IN THE WORLD OF TOMORROW...TODAY!

A BETTER LIFE STARTS HERE

(And our FREE CATALOG is packed with exciting and unusual ecological & physical science items—plus 4,500 finds for fun, study or profit . . . for every member of the family.)

ERECT A "PRO" WEATHER STATION

Match your forecasting skill with **anyone!** Set up permanent meteorology sta. for reliable readings: windspeed, precipitation, barometric pressure, temp., humidity; get wind-chill, cloud types. Top qual. equipt.: rooftop remote reading pneumatic windspeed ind.; 11" rain gauge; holosteric barometer (inches, etc.); hi-lo self register thermometer; wet-dry bulb hygrometer. More!

No. 80,216E (w/372 PG. LOG)..........$59.95 Ppd.
BEGINNER'S KIT: COMPL., LOW COST
Stock No. 71,022E..........$17.00 Ppd.

AUTHENTIC SCALED WINDMILLS

Real-thing replicas show wind direction, wheel silently revolves on ball bearings. Give your grounds unique rural charm! Great centerpiece for planter, flowers. Use to hold yard light, house number, sign or as mailbox. For school, a fine "energy crisis" science project—does everything but pump water. Heavy gauge steel, durable outdoor finish; aluminum color w/red trim.

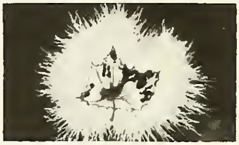
No. 71,923E..(17" DESK MOD.)..........$10.95 Ppd.
No. 71,924E..(4½'—14 LB)..........$32.50 Ppd.
No. 85,229E..(8'—46 LB)
$44.95 FOB

"FISH" WITH A MAGNET

Go treasure hunting on the bottom! Fascinating fun & sometimes profitable! Tie a line to our 3½ lb. Magnet—drop it overboard in bay, river, lake or ocean. Troll it along bottom—your "treasured" haul can be outboard motors, anchors, other metal valuables. 3½ lb. Magnet is war surplus—Alnico V Type—Govt. cost twice our price. Lifts over 40 lbs. on land—much greater weights under water.

Stock No. 70,570E 3½ lbs..........$11.50 Ppd.
Stock No. 60,215E 1½ lbs..........$6.50 Ppd.

NEW! KIRLIAN PHOTOGRAPHY KIT!



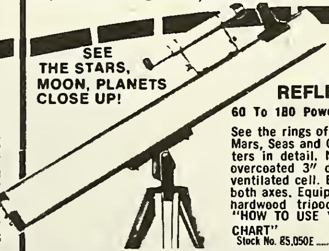
Experiment in the fascinating new field of "Kirlian" electrophotography—images obtained on film without camera or lens by direct recording of electric charge transmitted by animate & inanimate objects. Each "aura" differs from another—animate aura said to change corresponding to physical changes. $50 Kit gives everything needed except film including portable darkroom, double transformer isolated from power source; complete instructions.

Stock No. 71,938E..........$49.95 Ppd.

PRO ELECTRONIC SOUND CATCHER

Parabolic mike w/18¾" reflecting shield & 2 I.C.'s in amplifier magnifies signals 100X that of omni-directional mikes. Catch a songbird ½ mile off; QB's huddle strategy; sounds never before heard. Super directivity gives highest signal to noise ratio poss. Safe: auto. cuts off ear damaging noises. Earphones, tape recorder output, tripod socket. Req. two 9v trans. batt. (not incl).

No. 1649E.....(5½ LB.)..........$299.00 Ppd.
BIG EAR "TOY" MODEL #80,176E..........$26.50 Ppd.



SEE THE STARS, MOON, PLANETS CLOSE UP!

3" ASTRONOMICAL REFLECTING TELESCOPE

60 To 180 Power. Famous Mt. Palomar Type

See the rings of Saturn, the fascinating planet Mars, Seas and Craters of the Moon, Star Clusters in detail. New improved, aluminized and overcoated 3" diameter f/10 primary mirror, ventilated cell. Equatorial mount with locks on both axes. Equipped with 60x finder telescope, hardwood tripod. Included FREE: VALUABLE "HOW TO USE YOUR TELESCOPE" book; "STAR CHART"

Stock No. 85,050E..........$36.95 Ppd.

DELUXE 3" REFLECTOR TELESCOPE
Stock No. 80,162E..........$66.50
4¼" REFLECTOR TELESCOPE (45x to 270x)
Stock No. 85,105E..........$115.00 FOB
4¼" REFLECTOR TELESCOPE WITH CLOCK DRIVE Stock No. 85,107E..........$149.95 FOB
6" REFLECTOR TELESCOPE Stock No. 85,187E..........$222.50 FOB
6" REFLECTOR W/(ELECTRIC) CLOCK DRIVE No. 85,086E..........$259.50 FOB

ORDER TODAY! COMPLETE AND MAIL

EDMUND SCIENTIFIC CO.
300 Edscorp Building, Barrington, N.J. 08007

How Many	Stock No.	Description	Price Each	Total

PLEASE SEND ☐ **GIANT FREE CATALOG "E"** MERCHANDISE TOTAL $
ADD HANDLING CHARGE: $1.00 ON ORDERS UNDER $5.00; 50¢ ON ORDERS OVER $5.00
TOTAL $

30 DAY MONEY-BACK GUARANTEE
YOU MUST BE SATISFIED OR RETURN ANY PURCHASE IN 30 DAYS FOR FULL REFUND

NAME ____________
ADDRESS ____________
CITY ____________ STATE ____________ ZIP ____________
I enclose ☐ check
☐ money order for $____________

MAIL COUPON FOR GIANT FREE CATALOG!

180 PAGES • MORE THAN 4,500 UNUSUAL BARGAINS

Completely new '74 Catalog. Packed with huge selection of telescopes, microscopes, binoculars, magnets, magnifiers, prisms, photo components, ecology and Unique Lighting items, parts, kits, accesories — many hard-to-get surplus bargains. 100's of charts, illustrations. For hobbyists, experimenters, schools, industry.

EDMUND SCIENTIFIC CO.
300 Edscorp Building, Barrington, N. J. 08007
Please rush Free Giant Catalog **"E"**

Name____________
Address____________
City____________State____________Zip____________

enjoy the treasures of mother earth!

the collector's cabinet

1000 Madison Ave., New York, N.Y. 10021
"the treasure house of natural history!"

Branches: Dania, Fla., Miami Beach, Fla., Syracuse, N.Y., Chadds Ford, Penna., Springfield Mall, Virginia. (Franchise information available)

Also at Bloomingdale's, N.Y. and 144 other fine dept. stores nationwide. Write for the store nearest you. Catalog "H" and 7 jumbo color postcards $1.00.

FREE CATALOGUE OF BOOKS
Natural History, Birds, Plants
Antiques and Collecting
New and Out of Print Titles
Inquiries Welcomed
Tolliver's Books
1634-AH Stearns Drive
Los Angeles, California 90035

You don't have to be rich to have a greenhouse!
Write for our catalog.
TURNER GREENHOUSES
Mt. Olive Highway, Goldsboro, N. C. 27530

FREE INFORMATION

WRITE TODAY to find out how you can receive a different, interesting and valuable Mineral Specimen each month, with detailed "come-alive" fact sheet. Get started today in this fascinating and educational hobby. FREE Natural Ruby Crystal when you join. Write today!

MINERAL OF THE MONTH CLUB
P.O. Box 487-HF **Yucaipa, Calif. 92399**

Great Family Fun!

Brown's Original "Hummy-Bird Bar" ® is the perfect choice. Its durability has stood the test of time. Watch hummers sip thru clear plastic cup family style four-at-a-time. (Actual photo) Glass bottle with detachable perch to keep off other birds. No rust, no drip. Beeproof. Guaranteed. Instructions. $3.50 plus 50¢ ea. hndlng & postage. Add 18¢ tax in Calif. No COD's. *Hummingbird Heaven*, 10726-N Samoa Ave., Tujunga, CA 91042. (Makers of the Oriole "Fun Bar") Made in U.S.A.

Additional Reading

BUDDHA CAVES (Page 24)

Yün-Kang: The Buddhist Cave-Temples of the Fifth Century in North China. S. Mizuno and T. Nagahiro. Kyoto University Press, Kyoto, 1954.

An Introduction to Chinese Civilization. J. Meskill. Columbia University Press, New York, 1973.

A Short History of Chinese Art. M. Sullivan. University of California Press, Berkeley, 1970.

Religion of India. M. Weber. The Free Press, Chicago, 1958.

TURTLE COLLAPSE (Page 34)

Between Land and Water. B. Nietschmann. Seminar Press, Inc., New York, 1973.

The Green Turtle and Man. J. J. Parsons. University of Florida Press, Gainesville, 1962.

So Excellent a Fishe. A. Carr. Natural History Press, Garden City, 1967.

Great Reptiles, Great Enigmas. A. Carr. *Audubon*, March, 1972.

GUNS OF THE TAU SUG (Page 44)

The Tausug. T. M. Kiefer. Holt, Rinehart and Winston, Inc., New York, 1972.

In Search of Southeast Asia. D. J. Steinberg et al. Praeger Publishers, Inc., New York, 1970.

Village Life in Insular Southeast Asia. B. J. Wallace. Little, Brown and Company, Boston, 1971.

NEW TOWN BIRDS (Page 54)

Nature in the Urban Landscape. D. Gill and P. Bonnett. York Press, Inc., Baltimore, 1973.

Open Land for Urban America. J. J. Shomon. The Johns Hopkins University Press, Baltimore, 1971.

Changes in Bird Life in Cambridge, Massachusetts, 1860–1964. C. F. Walcott. *Auk*, January, 1974.

HEROIN ADDICTION (Page 66)

Licit and Illicit Drugs. E. M. Brecher and Consumers Report Editors. Little, Brown and Company, Boston, 1972.

Drug Use in America, Problem in Perspective, Second Report. U. S. Commission on Marihuana and Drug Abuse. U. S. Government Printing Office, Washington, 1973.

Heroin Epidemics. L. G. Hunt. Drug Abuse Council, Washington, 1973.

Here's How to Preserve Natural History
Newly made especially for Natural History readers, it holds an entire year's subscription and is bound in brown smooth leatherette with gold lettering . . . $4.00 (including member's discount)

Bankers, Bones and Beetles
This book is an anecdotal history of The American Museum of Natural History and it's written with wit and affectionate irreverence by Geoffrey Hellman...$2.15 Post Paid (including member's discount)

NATURAL HISTORY MAGAZINE

BANKERS, BONES and BEETLES
Geoffrey Hellman
THE AMERICAN MUSEUM OF NATURAL HISTORY

Available . . .
the general guide to
The American Museum of Natural History
160 pages of information and photos describing the museum's collections, research and exhibits . . . $2.40 Post Paid (including member's discount)

The Museum Shop
The American Museum
of Natural History
79th and Central Park West
New York, New York 10024

Please send me the following . . .
☐ Natural History Magazine Binder
☐ Bankers, Bones and Beetles
☐ General Guide to the Museum

Please add Sales Tax where applicable.
I enclose ☐check ☐money order for
$ ________.

name ____________________
address ____________________
city ____________________
state ____________ zip ________

£125,000 ($300,000) and 2 years of loving labour went into this sumptuous Centennial Edition of

THE COMPLETE WORKS OF DICKENS

CHARLES DICKENS COMPLETE WORKS
DAVID COPPERFIELD I
CHARLES DICKENS COMPLETE WORKS
DAVID COPPERFIELD II
CHARLES DICKENS COMPLETE WORKS
OLD CURIOSITY SHOP I

As your introduction let us send you

FREE

Great Expectations

WITHOUT ANY PURCHASE OBLIGATION WHATSOEVER

BOUND IN EUROPE IN OLD WORLD STYLE

The quality of printing and binding in this Centennial Edition is seldom seen in the U.S.A. The covers have the look and feel of a kid glove. Their delicate design is 24 kt. gold. The books are full of gracious touches you have not seen in years: decorated endpapers, silk headbands, sewn-in bookmarks, period illustrations. A perfect expression of good taste in decorating as well as in literature.

Now . . . let these unforgettable characters of the world's master story-teller walk into your home.

Let this be your introduction to the most fascinating characters that any writer's genius ever created. The improvident Micawber, always waiting for something to turn up . . . Uriah Heep, the "so very 'umble" . . . honest Pegotty endlessly roaming in search of his seduced daughter . . . Sampson and Sarah Brass . . . Quilp . . . and poor little Nell . . . their very names breathe the magic gift of Charles Dickens for creating vivid characters. Every page you read comes alive with real people whom you'll love . . . hate . . . pity . . . and never forget! *Now meet them—treasure them in your home—in beautiful books worthy of the genius who created them.*

Rich heirloom bindings—classic illustrations

This sumptuous Centennial Edition of the Works of Charles Dickens took Heron Books in England £125,000 and 2 years of loving effort to create. The edition has taken British booklovers by storm, and is now available here at amazingly low cost. With classic-style printing, elegant gold-tooled rich-textured bindings, and the original illustrations of such famous Dickens artists as Cruikshank, "Phiz" and Tenniel, these books are treasures indeed. They will beautify your bookshelves, enrich your home, and delight you, your children, and generations to come—just as their tales have delighted generations past.

But you have to see them, take them in your hands, examine them lovingly to recognize their full value. We therefore make this fantastic offer: Accept as an outright gift one of the best loved Dickens classics "*Great Expectations*" . . . FREE! Simply mail the Free Dickens Coupon and discover the superb Centennial Edition without obligation to buy a single book!

Your opportunity to build a beautiful library—at low cost

If you are not absolutely convinced after reading and examining your first volume that the Centennial Edition represents a publishing venture of such unique beauty that you will always be proud to have such books in your home, then simply notify us within 10 days and your subscription will be cancelled without your having bought a single volume. And GREAT EXPECTATIONS will still be yours to keep.

But if you are as thrilled by the beautiful and elegant binding, as charmed by the many reproductions of the original illustrations, and as fascinated by the masterful Dickens narrative as we think you will be, then each month thereafter we will advise you in advance of every shipment, which you may accept if you wish at the special low subscriber price of $3.89 plus shipping. Each book will be identically printed and bound in Europe to the same high standards. But you will not have to take more than you actually want. You may terminate your subscription any time you decide your collection is as complete as you want it.

Limited Edition—reserve now. Clearly, an edition of this magnificence cannot be produced *en masse*. Our import quota is limited. Should it be over-subscribed, it may take some time before additional sets can be offered. To avoid disappointment, send the Free Reservation Coupon now.

HERON BOOKS, 201 Lincoln Blvd., Middlesex, New Jersey 08846

Free Reservation Coupon:

HERON BOOKS, 201 Lincoln Blvd.,
Middlesex, New Jersey 08846

Please send me as an OUTRIGHT GIFT the sumptuous Centennial Edition of *Great Expectations*. Accepting this gift does not obligate me to order any further books, not even one!

You will send me advance notice of all matching Dickens Centennial Edition volumes as they become available, and I may reject any shipment merely by notifying you. I may return any volume you send without penalty after a 10-day free examination, or I may keep it for just $3.89 plus shipping.

You will cancel my subscription whenever I notify you I consider my collection complete. There is no minimum number of books I must order—*not even one! Great Expectations* is mine to keep FREE in any case.

Signature________________________

Print Name________________________

Address________________________

D240

City________________________

State____________ Zip____________

FOR CANADA: Return coupon to us. Special arrangements for servicing Canadian subscribers have been made.

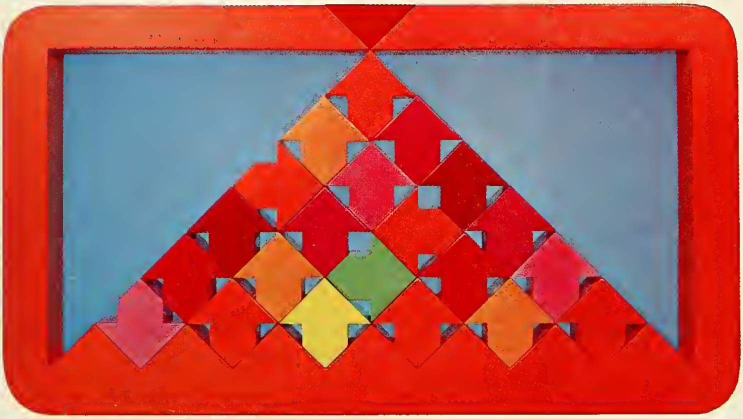
D11

photographer: marty evans

The real

Our election laws and traditions reflect the country as it was decades ago. The time has come to ask some basic questions.

How long should elected officials serve?
Is there still a need for the electoral college?
Should taxpayers foot the bill for election campaigns?
Does our present system truly provide one vote for each person?
Is our political structure so big that officials are too far from those who elect them?



artist: per vollquartz "government: triangle and people"

The ideal

A nation in which those elected truly represent the will of those who elected them—for the good of all.

AtlanticRichfieldCompany

Our goal was to make getting there as much fun as being there.

When we designed our GMC MotorHome, we had something quite special in mind. We wanted a motorhome that would actually be fun to drive.

Which is why a GMC MotorHome looks the way it does. Aerodynamic. And low—lower than any other motorhome. So it can handle crosswinds. And corners.

That's also why we've provided it with front-wheel drive, a 455-cubic-inch V-8 with automatic transmission, and tandem rear wheels with air suspension. So it can handle highway speeds. And off-highway bumps.

Not that we've ignored living comfort. In fact, 15 floor plans, in four different color-coordinated decors, are available.

If you want specifics, send for our 28-page color catalog. Simply write: GMC MotorHome Headquarters, Drawer Y, Dept. 307, Lansing, Mich. 48909.

Better yet, see your local GMC MotorHome dealer.

The GMC MotorHome. It doesn't look like a box. It doesn't ride like a truck.

GMC

The MotorHome from General Motors.

GMC
1055-CR
GM
MARK OF EXCELLENCE

NATURAL HISTORY

AUGUST-SEPTEMBER 1974 • $1

Henry Lewis has the knack of surrounding himself with the best.

Like his New Jersey Symphony. Birgit Nilsson. Marilyn Horne. Luciano Pavarotti. Pioneer.

What with recording sessions and concerts you'd imagine conductor Henry Lewis might want to take a vacation from music. Not so. In between he catches up with his own listening on his Pioneer high fidelity system.

Henry Lewis takes his music seriously. But he also likes to have fun with it. His Pioneer TX-9100 stereo tuner and SA-9100 integrated stereo amplifier enable him to continue his musical adventures at home.

Pioneer is renowned for producing the finest tuners made. The TX-9100 substantiates this with remarkable specifications like 90dB selectivity, 1.5uV FM sensitivity and a 1dB capture ratio. Audio magazine summed it up perfectly with, "You can't buy better audible performance than is achievable with Pioneer's TX-9100 at *any price.*"

Only Pioneer's SA-9100 integrated amplifier could possibly match the performance of this excellent tuner. As High Fidelity magazine put it, "... It's performance is so exceptional, and the so many extras in the way of switching options, and so on, so eminently useful, that we find it the most exciting piece of audio hardware." Small wonder with features like the unique twin stepped tone controls that custom tailor listening to an enormous variety of tonal variations. And a power output of 60+60 watts RMS (8 ohms, both channels driven) with an amazingly low 0.1% distortion from 20 Hz to 20,000 Hz.

Pioneer's TX-9100 and SA-9100 assure conductor Henry Lewis the same absolute control of his music at home as he can achieve with his baton on the podium.

TX-9100 - $349.95;
SA-9100 - $449.95, including walnut cabinets.

U.S. Pioneer Electronics Corp., 75 Oxford Drive, Moonachie, New Jersey 07074 / West: 13300 S. Estrella, Los Angeles 90248 / Midwest: 1500 Greenleaf, Elk Grove Village, Ill. 60007 / Canada: S.H. Parker Co.

PIONEER
when you want something better

NATURAL HISTORY

Incorporating Nature Magazine
Vol. LXXXIII, No. 7
August-September 1974

The American Museum of Natural History
Gardner D. Stout, President
Thomas D. Nicholson, Director

2 Authors

8 Letters

12 Disappearance of the Historic Ship *Tijger*
Christopher L. Hallowell
Builders rarely welcome archeologists at construction sites.

30 This View of Life: On Heroes and Fools in Science
Stephen Jay Gould
When viewing yesterday's achievements, today's spectacles often act as blinders.

34 Images of a Vibrant World
The winners—and one loser—of the 1974 Natural History Magazine Color Photography Competition.

42 Desert Farmers: Ancient and Modern
Michael Evenari
We have begun to appreciate the skills of Negev agriculturists of three thousand years ago.

50 The Spiral Way
Gerald Oster
Nature abhors a straight line.

56 Sun, Sand, and Sea Lions
G. Causey Whittow
Did you ever try sunbathing while wearing a fur coat and a thick layer of blubber?

64 A Matter of Taste: The Ritual of Maize
Raymond Sokolov

72 Driftwood Fantasy
Robert Sommer
Art is in the mind of the beholder.

80 Sky Reporter: How Old Is the Universe?
Robert Jastrow

84 Celestial Events
Thomas D. Nicholson

86 Bios: The Membrane Barrier
Arthur W. Galston
How do cells get the message?

92 Birding by the Book
A review by Robert Arbib
A guide to guides—ranging from $.95 to $5,940.

100 Additional Reading

102 Announcements

Cover: *Keith A. Tsubata's composition of giraffes won him First Prize in The Natural World category of the 1974 Natural History Magazine Color Photography Competition. Other prizewinning pictures and comments on the contest begin on page 34.*

Alan Ternes, Editor
Thomas Page, Designer
Board of Editors:
Sally Lindsay, Frederick Hartmann,
Christopher Hallowell, Toni Gerber
Carol Breslin, Book Reviews Editor
Florence G. Edelstein, Copy Chief
Karen Bierstedt, Copy Editor
Angela Soccodato, Art Asst.
Diane Pierson, Editorial Asst.
Lillian Gindea
Rosamond Dana, Publications Editor
Editorial Advisers:
Dean Amadon, Dorothy E. Bliss,
Mark Chartrand, Niles Eldredge,
Vincent Manson, Margaret Mead,
Thomas D. Nicholson, Gerard Piel,
Richard G. Van Gelder

David D. Ryus, Publisher
L. Thomas Kelly, Business Manager
Sue Severn, Production Manager
Ernestine Weindorf, Administrative Asst.
Ann Brown, Circulation Manager
Joyce E. Klutch, Asst.
Joan Mahoney
Harriet Walsh

Harvey Oshinsky, Advertising Manager
Salesmen: Gordon Finley
Harry R. Jeter, Vic Asselin
Eileen O'Keefe, Production
Katrin Magnusson, Asst.

Publication Office: The American Museum of Natural History, Central Park West at 79th Street, New York, N.Y. 10024. Published monthly, October through May; bimonthly June to September. Subscriptions: $8.00 a year. In Canada and all other countries: $10.00 a year. Second-class postage paid at New York, N.Y. and at additional offices.

Copyright © 1974 by The American Museum of Natural History. No part of this periodical may be reproduced without the written consent of Natural History. *The opinions expressed by authors do not necessarily reflect the policy of The American Museum.*

Natural History *incorporating* Nature Magazine *is indexed in* Reader's Guide to Periodical Literature.

Change of address notices, undeliverable copies, orders for subscriptions, and other mail items are to be sent to
Natural History Magazine,
Membership Services, Box 6000,
Des Moines, Iowa 50306.

Perfect Focus at 1 inch, and less, with a Sankyo "Close Up" Movie Camera

Did you ever want to take close up movies of a travel itinerary or a map? Or a tight close up of a child's smile when two or three baby teeth were missing? Most movie cameras can't focus sharply at less than three feet.

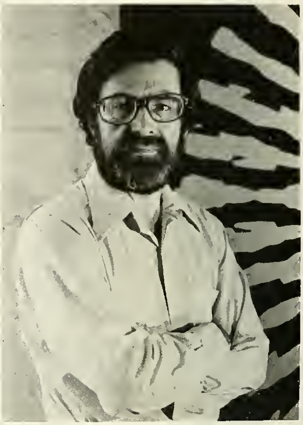
With the fully-automatic Sankyo "Close Up" Movie Cameras, you can shoot as close as the lens itself and be in perfect focus. That's Omm! Take close up movies of tropical fish, flowers, foliage...whatever turns you on. Zoom in, zoom away...to infinity.

A Sankyo "Close Up" opens a new world of exciting, fun filled, creative movie making. There's a Sankyo camera with your kind of features and your kind of price tag at your camera dealer now.

Sankyo Seiki (America) Inc.
149 Fifth Avenue, New York, N.Y. 10010
West Coast Branch:
13000 S. Athens Way, Los Angeles, Calif. 90061

Authors

While exploring an excavation site along the banks of the Hudson River near Croton, New York, **Christopher L. Hallowell** learned from local archeologists that the remains of a seventeenth-century Dutch ship lay beneath lower Manhattan's World Trade Center. Interested in every aspect of New York's early history, he scoured museums and libraries and interviewed numerous archeologists and historians to learn more about the ship and how it came to be buried underneath the 110-story buildings. He also questioned construction workers to find out why the ship was never unearthed. Hallowell's full-time occupation is associate editor of *Natural History*.



The discovery of ancient papyri that described the abundant harvests produced in the Negev Desert some 2,500 years ago led **Michael Evenari** and his research colleagues, Leslie Shanan and Naphtali Tadmor, to spend almost twenty years in an effort to develop the agricultural potential of the region. Following the outline of ancient water channels, the research team attempted to duplicate the technique of runoff agriculture used by the desert's former inhabitants. The experiment was so successful that Evenari, now a professor of botany at the Hebrew University in Jerusalem, has exported the principle to a number of countries with arid regions.

Does a sea lion sweat? **G. Causey Whittow**, professor of physiology at the University of Hawaii, looks for answers to such questions in order to understand how marine mammals evolved from their ancestral land habitats to their present aquatic existence. He has studied the California sea lion since 1968. Concentrating on the physiological and behavioral mechanisms that enable these animals to regulate their temperature while on land, Whittow has worked out a thermal budget that helps explain how a mammal adapted to life in cold water can survive on warm rocks and beaches long enough to breed. A native of Great Britain, Whittow is presently in Malaysia studying the dugong. (Sea lions do sweat—a little.)

"When I stare at strobe lights, I see an array of synchronously moving figures that suggest spirals," says **Gerald Oster**. That phenomenon, combined with a background in mathematics, may account for his long-standing fascination with this particular geometric figure. A professor of biophysics at the Mount Sinai School of Medicine of the City University of New York, Oster paints and makes constructions in his spare time. He created the mathematical art form known as moiré patterns and his work has been exhibited in some fifty museums. Oster first appeared in the pages of *Natural History* in August, 1972, with his article "Conception and Contraception."

For the past five years, **Robert Sommer** has walked along many shorelines observing how people create art from driftwood. Occasionally he has even made his own driftwood creations. A professor of psychology and environmental studies for eleven years at the University of California at Davis, Sommer's principal outside interest is the many forms street art takes. He would like to increase the public's visual sensitivity and eliminate the drabness and clutter of urban areas. In pursuing his studies, Sommer has traveled throughout the country photographing street sculpture and murals. His book *Tight Spaces*, on security architecture and the effects of confinement, has just been published. His next book, on art in public places, is scheduled for publication this fall.

BEAUTY BEGINS HERE...

in nature, in the trees that give charm to your house and shade to your garden. That's where you'll find it. But healthy, beautiful shade trees don't just happen these days. Continued poor environment, attacks by disease and insects often kill or disfigure the ones we value most. Much of this loss can be avoided, however, by accurate diagnosis and the timely use of scientific methods.

These problems are not new to us. Long before their ecological condition was thought to be so serious we were spending substantial amounts of time, talent and money in research to help save America's trees.

If you are concerned about your trees, call your local Bartlett representative today and let him show you not only how scientific care will make them more beautiful, but how it will keep them that way.

BARTLETT

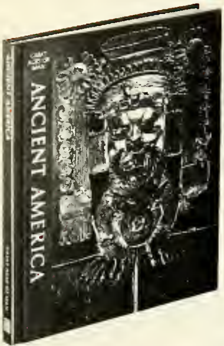
BARTLETT
TREE EXPERTS

**Home Office, 2770 Summer Street,
Stamford, Conn. 06905**

Research Laboratories
and Experimental Grounds,
Charlotte, N.C.

Local Offices from Maine to
Florida and west to
Illinois and Alabama.

5,000 years of the world's



ANCIENT AMERICA

500 B.C. to 1550 A.D.—the flourishing of three great cultures in total isolation: Maya, Inca and Aztec. The Spanish conquest of Mexico and Peru.

CLASSICAL GREECE

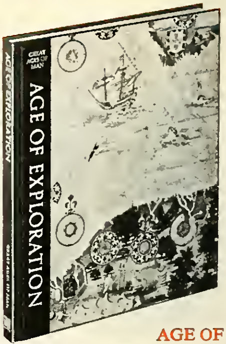
CLASSICAL GREECE

Beginnings of democracy, philosophy, science. First Olympic games. Persian destruction of the Acropolis. Superhuman feats of Alexander the Great.

CRADLE OF CIVILIZATION

CRADLE OF CIVILIZATION

Unearthing treasures of man's earliest civilizations in Mesopotamia, Sumer, Babylonia, Assyria. Man's first cities; beginning of writing, law, mathematics.



AGE OF EXPLORATION

With unreliable maps and tiny ships, the explorers of the 15th and 16th centuries sailed out into the unknown to change the future of the world.

Everything worth knowing about the
GREAT AGES OF MAN
brought to vivid life by TIME LIFE BOOKS

TIME-LIFE BOOKS invites you to journey through 5,000 years and the dozens of great cultures that have helped to create the civilized person you are today. In ancient Africa, Greece, Egypt, India, China, Japan and America, our ancestors invented calendars, writing, plumbing, clocks... designed bridges, highways, buildings . . . wrote poetry, philosophy and law...painted and sculpted works of unsurpassed power and beauty.

In a unique series of books that chronicles the fascinating story of civilization, the editors of TIME-LIFE BOOKS have brought together many of the world's most eminent scholars and historians, archeologists and anthropologists. The result is GREAT AGES OF MAN—21 superb volumes depicting the spectacular drama of man's journey from primitive ignorance to the scientific marvels of the 20th Century.

Stunningly produced and illustrated, these books disclose the world as it really was, with everything worth seeing and knowing brought to vivid life. Intimate portraits of history's most remarkable personalities, as well as authentically detailed descriptions of how people lived their daily lives, will help you see these ancient worlds in their most human terms.

Your introduction to GREAT AGES OF MAN is *Ancient Egypt* — a richly evoked, authoritative portrait of a people united in 27 centuries of glory, a span of achievement that has few rivals in human history. And it's yours for 10 days free — full details are on the opposite page.

Begin your fabulous journey with

ANCIENT EGYPT

enjoy it for 10 days

FREE

Typical of the readers' enthusiastic response:

"I would like to take the opportunity to congratulate you for publishing the finest collection of books about man I have ever read. The pictures in each of the books are breathtaking, but even more important the knowledge one learns and gains from reading the Great Ages is priceless."

M. Kardian, Baltimore, Md.

"Your series of books is very, very fine in every way. I am proud to have them on my book shelves, and I certainly enjoy reading them. They have helped me in many ways in my high school English classes of 150 students."

Mrs. Helen S. Fields, Fresno, Calif.

TIME LIFE BOOKS invites you on a spectacular trip to the beginnings of everything you are today . . .

THE EMERGENCE OF MAN

Enjoy the introductory volume

The Missing Link for 10 days free

The Missing Link

TIME-LIFE BOOKS, DEPT. 3410
TIME & LIFE BUILDING
CHICAGO, ILLINOIS 60611

Yes, I would like to examine *The Missing Link*. Please send it to me for 10 days' free examination – and a FREE Wall Chart and Map of milestones of evolution – and enter my subscription to THE EMERGENCE OF MAN. If I decide to keep *The Missing Link*, I will pay $5.95 ($6.95 in Canada) plus shipping and handling. I then will receive future volumes in THE EMERGENCE OF MAN series, shipped a volume at a time approximately every other month. Each is $5.95 ($6.95 in Canada) plus shipping and handling and comes on a 10-day free examination basis. There is no minimum number of books that I must buy and I may cancel my subscription at any time simply by notifying you.

If I do not choose to keep *The Missing Link*, I will return the book within 10 days, my subscription for future volumes will be canceled and I will not be under any further obligation. I may keep the free Wall Chart and Map in any case.

Name ____________________
(please print)

Street ____________________

City ____________ State ____________ Zip ____________

Residents of Canada: Mail form in envelope.
Schools and Libraries: Order Library Style Bindings from Silver Burdett Co., Morristown N.J. 07960. Eligible for Titles I, II funds.

Natural History

FIRST CLASS
PERMIT NO. 22
CHICAGO,
ILLINOIS

BUSINESS REPLY MAIL
No postage stamp necessary if mailed in the United States

Postage will be paid by

TIME
LIFE
BOOKS

Time & Life Building
Chicago, Illinois 60611

And, as your introduction to
THE EMERGENCE OF MAN
yours to enjoy for
10 days free...
The Missing Link

Plus an absolutely FREE
Wall Chart and Map
depicting
man's
significan
"firsts"

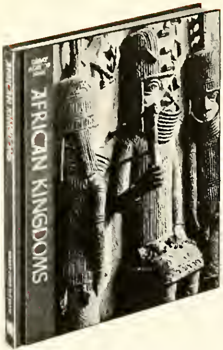
TIME
LIFE
BOOKS

greatest civilizations

ANCIENT CHINA

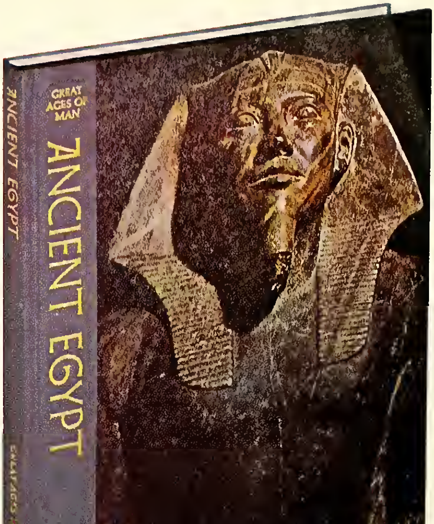
ANCIENT CHINA

The fabled cities, sumptuous palaces, emperors and peasants, philosophers and soldiers, poets, artists and inventors of six great ancient dynasties.



AFRICAN KINGDOMS

The Africa you never learned about in school—1,000 diverse cultures and languages, splendid cities, bustling ports, the fabulous Timbuktu.



SPORT FOR THE FAMILY Fowling and fishing amidst the tall papyrus reeds along the banks of the Nile was a sport enjoyed by the whole family, as shown in this ancient portrayal, a stock scene in Egyptian tomb paintings. At left, the noble hurls throwing sticks at a

…at right, his upraised hand may have held a … hurled. In this scene the lord's wife clings to his … daughter to his leg (a stylized way of depicting the … group). Another daughter appears in the background.

imitating her father's hunting form. The family often took a civet along on these outings to flush birds out of the reeds. For rougher sport, a noble rode into the desert to hunt gazelle and antelope, taking along a pack of trained hunting dogs

Size: 8¾" x 10¾". Nearly 200 pages. Over 152 illustrations, 63 in full color.

As your introductory volume to this series, you are invited on a 10-day visit to *Ancient Egypt* – a visit that will take you behind the rigid death masks, the somber tombs, the unsmiling portraits of their historic image. You'll meet the Egyptians as they really were at the height of their splendor: a gay, romantic people who glorified death only because they saw it as a happy continuance of life.

You'll learn how the Egyptians built the Great Pyramid at Gizeh with stone blocks weighing up to 15 tons apiece, fitted them together as preciously as a necklace clasp—and sealed it off so effectively (from the *inside*) it took looters 400 years to gain entrance.

You'll see both their communal and private lives: they wrote lyric poetry to lost loves . . . women used hair curlers, tweezers and eye shadow . . . they allowed their workers "sick leave," yet they suffered history's first recorded labor strike . . . they worked out the beginning of geometry, yet they had trouble with fractions.

In *Ancient Egypt*, Lionel Casson, Professor of Classics at New York University, gives you an intimate, authoritative portrait of a people who formed the world's first united nations more than 3,000 years before Christ – and managed to sustain it for an astonishing 27 centuries. And to add to your pleasure and comprehension, you'll receive, with this volume, a 5,200-word introduction to the Great Ages of Man series entitled "What Man Has Built," by Jacques Barzun, distinguished scholar and critic.

Examine *Ancient Egypt* in your home for 10 days free. If you're not satisfied, for any reason, simply return it. But if you feel it lives up to your expectations and wish to keep it, pay only $5.95 plus shipping and handling. Then you will receive future volumes at regular intervals – at the same price and with the same free 10-day trial period. There is absolutely no cost or obligation, so why not browse through 27 centuries of Egypt's glory. Mail the bound-in postpaid order form today. If card is missing write to: TIME-LIFE BOOKS, Dept. 2601, Time & Life Building, Chicago, Ill. 60611.

Letters

More on Evolution

The special creationists are in the same bed with the biological determinists—and strange bedfellows they are not. Norman D. Newell ["Evolution under Attack," April, 1974] describes them as religious fundamentalists with views ranging "from conservative to progressive, and they often find no conflict between science and religion."

Politically, however, these people definitely lean toward right-wing extremism. Though they may agree to disagree on individual issues, their thought is typified in such voices as Kenneth Goff, leader of the neofascist Soldiers of the Cross; Gerald L. K. Smith, anti-Semitic publisher of *The Cross and the Flag;* Robert Welch, founder of the John Birch Society; Billy Hargis of the Christian Nationalist Crusade; Raymond Hoiles, publisher of the Santa Ana, California, *Register;* Joe Pyne, TV phenomenon; George Crocker, columnist; and W. D. Fard, founder of the Black Muslims.

W. John Palmer
Northern Michigan University
Marquette, Michigan

All believers do not view the Flood as being worldwide. Many feel it could have been of a local nature.

Since the word "day" is used in several ways in the opening chapters of the Book of Genesis, many Bible believers do not equate the creation days to 24-hour periods. Extensive time allowing for the geological ages is accepted.

The Bible states God created, but it does not say how. A person may be a fundamental believer and yet allow for an extended period wherein biological principles of heredity and natural selection could be utilized.

Many Bible believers acknowledge microevolution, a small change within a general grouping. To admit to macroevolution, however, that all forms of life had a common ancestry and proceeded from a nonlife origin, is a travesty of the biblical record.

Paul F. Caron
Southington, Connecticut

Newell fails sadly when appraising the position of special creation. Creationists do not believe that species are "immutable." Special creationists hold that life was created according to kind. They hold that "kinds" may well refer to the genus or a larger classification. They don't accept the theory of general evolution, that all existing life has evolved from one or a few simple cells. They do see change, variation, and adaptability in nature.

Creationists do not believe that nature is "static." They would allow for a marked degree of uniformitarianism. As catastrophists they hold that both the universal flood and continental glaciation brought revolutionary changes to the earth and its life. They believe these were unprecedented in both scope and time.

Newell is obviously correct when he states: "Time is crucial to the process of evolution." Nowhere is it more desperately needed and sought than in the theory of human evolution. Time is needed in order to account for the evolution of the human skull from that of Australopithecus to that of the Neanderthal or Cro-Magnon. The 250,000 or 300,000 years postulated by a considerable number of Quaternarians is woefully inadequate for a virtual tripling of the skull in size, as theorized by classic Darwinism.

It ought to be candidly admitted that the honeymoon of radioactive dating is at an end. It is a formidable difficulty to ascertain the quantity of radioactive materials in the ocean and atmosphere prior to 5,000 years ago. The correlation of radiocarbon dating with that of dendrochronology can only go back about that far. It is therefore sheer conjecture to say as Newell does: "Carbon 14 dating is effective in dating objects up to 50,000 years old." Potassium argon dating has also outlived its honeymoon period. Its findings have frequently clashed with the dating of stratigraphical geology.

The sudden appearance of all the main phyla (except vertebrates) occurs in the Cambrian. These forms had all of the complexity of invertebrate life today. Their fossils do not confirm the Darwinian concept of gradual development from a few simpler forms. The fossils of later conjectured ages often appear as if full-blown, and the gaps connecting species are consistently wide and unconnected.

Paleobotany has as yet not been able to connect the seven major groups of plants. The appearance of the flowering plants is still as much of an "abominable mystery" as it was to Darwin. Entomology and ornithology do not have sufficient fossils to affirm evolution.

Extinction by catastrophic means is the usual fate of species. The fossils are found in stratigraphic cemeteries caused by either local or larger areas of inundation and coverage. General evolution is absolutely dependent upon paleontology for proof of its occurrence. Since the record is admittedly incomplete, so also is the proof.

Special creation has been the only other recognized alternative to the theory of organic evolution. It has a history of acceptance as lengthy as that of evolution. As a scientific model, it is no more theological than is general evolution.

William A. Springstead
Pinedale, Wymoming

Dr. Newell Replies:

Donald V. Etz [June-July] opposes "Darwinian dogma" because it is atheistic and "neither true nor

The Old English 48-pc. "GOLDEN PUB" Set

A sparkling
crystal glassware service...
personalized with your initial...22K gold-rimmed

only $29^95 Superb value at this low price!

The warmth, the charm, the good taste of the 17th Century English pub . . . now *reborn* in a 48-piece glassware set of sparkling blown crystal. In keeping with this centuries-old tradition of hospitality, modern American craftsmen have fashioned glasses that will give you everything you'll ever need or want for correct, knowledgeable bar and table service in your home or office.

The set is truly impressive. Hold one of the glasses. You'll find that the contoured shape has been carefully designed to fit the hand comfortably, naturally. Set it down . . . see how the heavy sham bottom prevents tipping or spilling. Clink two of these glasses together. They even *sound* like fine crystal.

Each of the 48 pieces in this magnificent set will be decorated with the initial of your choice — fittingly, in classic Old English style. The initials are carefully engraved and satin-etched for permanent beauty. For added good looks, each glass is elegantly rimmed with a rich band of 22K gold.

A superb set — and at just 62¢ per glass, a superbly low-priced gift idea! Order soon. Please specify single initial desired.

COMPLETE SET INCLUDES 8 EACH OF THE FOLLOWING:

- 16-ounce Cooler
- 9-ounce On-the-Rocks
- 12-ounce Goblet
- 9-ounce Tumbler
- 6-ounce Sherbet/Champagne
- 6-ounce Juice/Cocktail

The UNIQUE Guarantee

Unique ideas, unique quality, unique value — accurately described, promptly shipped. Plus a promise: you must be pleased with your purchase always (a month from now or a year from now) or your money back fast. That's a UNIQUE guarantee!

unique Products Co. HANOVER, PENNA. 17331

MAIL THIS COUPON TODAY

UNIQUE Products Co., Dept. Z-918, Hanover, Pa. 17331

Rush me (quantity) ________ **48-pc.** Glassware Set (s) (No. **Z92056D**) at **$29.95** plus $3 shipping and handling per set.
(Pa. and Md. residents add appropriate tax.)

Initial desired: ________ ☐ Check or M.O. enclosed

☐ Charge Credit Card below

☐ Carte Blanche ☐ Diners Club

☐ BankAmericard ☐ American Express

☐ Master Charge Interbank No.________

Account No. ________ Expiration Date ________

Signature ________

PRINT NAME ________

ADDRESS ________

CITY ________ STATE ________ ZIP ________

Douglas Kirkland

John Dominis

Discover the exciting, colorful, always-something-happening world of Nikon!

Look around you through the viewfinder of a Nikon system camera. You see drama unfold in street scenes on a city block—in the insect world in your backyard. You respond to the fascination of strange cultures—to the thrill of humanity in action. And you find yourself becoming involved in life as never before.

A Nikon camera inspires you to do it with confidence. The top professionals rely on its precision and competence, and on the magnificent picture quality of its Nikkor lenses. What's more, you feel comfortable with it from the start, thanks to Nikon "human engineering" and to advanced automatic features that let you keep your mind on the picture at all times.

Nikon offers you a choice of four up-to-date cameras, all backed by a system of more than forty Nikkor lenses and an endless array of accessories to stretch your photographic horizon.

Nikkormat FTN is moderately priced and delightfully uncomplicated. Its "center-weighted" thru-the-lens meter system gives you correct exposure quickly and easily in any situation. The always-bright viewfinder keeps exposure information right before your eye.

Nikkormat EL, exciting new "automatic" 35 with electronically-controlled shutter, provides fully automatic exposure settings. Nikon-designed integrated circuitry links this unique shutter with the "center-weighted" meter system for exceptional, reliable exposure accuracy with any of forty Nikkor lenses.

Nikon Photomic FTN literally revolutionized 35mm photography in the hands of the world's foremost photojournalists. Interchangeable lenses, finders, finder screens and camera backs endow it with total versatility.

Nikon F2 ranks as today's premier 35mm camera. Among its features are shutter speeds from 10 seconds to 1/2000th, multi-exposure control, totally flexible modular construction, and system capabilities that include fully automatic exposure control and interchangeable motor drives.

Your Nikon dealer will help you select the Nikon system camera that's best for you. He'll also tell you about the Nikon School of Photography, the famous weekend short course that's traveling to all parts of the U.S.A. See him soon—and discover a whole new wide, wonderful world!

Nikon Inc., Garden City, N.Y. 11530. Subsidiary of Ehrenreich Photo-Optical Industries, Inc.

F
Nikon
Nikon
EL
Nikkormat
Nikkormat

useful." Scientists who work with the history of the universe—nearly all astronomers, geologists, biologists, palentologists, and anthropologists—divide evolution into two compartments: evidence and explanations. They agree that evidence of great changes throughout the universe is compelling. Consequently, they accept evolution as a fact of all nature. This acceptance is neither dogma nor assumption. In one aspect or another evolution is being tested and verified daily in such disparate fields as medical research and astrophysics. The more sophisticated creationists are aware of this, but they are preoccupied by the uniqueness and separateness of man in the history of life, and they carefully avoid overwhelming evidence of the unity and kinship of all life.

The second aspect of evolution concerns theories, or explanations, which, of course, change with advancing knowledge. Among theories of organic evolution, Darwin's natural selection has been by far the most successful. But many changes have been made since Darwin's day. Remaining unchanged, however, is the general conclusion that nearness of kinship is indicated by degree of resemblance. That concept gives meaning and order to comparative anatomy, genetics, molecular biology, and immunology. But the creationists reject any kinship between major "kinds," which they say were separately created to perform separate ecological roles. It seems that the separate phyla of plants and invertebrates are individual "kinds," but man is delegated in their opinion to a separate category quite unrelated to other primates.

Scientists will be astonished to learn that evolution is "in retreat." Only by a very warped logic can it be regarded as "destructive" of morals. Progressive theologians in all of the major religions have no difficulty accommodating this and other areas of scientific knowledge to their religious convictions.

Dale Younce [June-July] suggests that "the theory of organic evolution is philosophy, not science." Since the aim of both philosophy and science is to promote understanding of the universe, they broadly overlap.

The presuppositions of creationists and evolutionists alluded to by Mr. Younce are clear enough. The creationists put their faith in the fourth-century edict of St. Augustine: "Nothing is to be accepted save on the authority of Scripture, for greater is this authority than all the powers of the human mind." The evolutionists prefer the advice from the Book of Job (12:7–8): "Ask now the beasts, and they shall teach thee. . . . Or speak to the earth, and it shall teach thee. . . ."

William A. Springstead stresses gaps and deficiencies in evolutionary knowledge. These constitute the main business of many research scientists. The gaps and deficiencies are really not destructive of evolutionary theory. They have been brought to light by the research scientists themselves and not by creationists. Science does not claim or expect perfection.

The steady increase of consistency of ancient dates obtained by measurements of present changes, and by cross-checking independent results from radioactive isotopes, fossils, paleomagnetic reversals, and a variety of geologic methods promotes confidence in modern geochronology. The creationists are on thin ice, indeed, in challenging modern atomic physics with only incredulity as a weapon.

Paleontologists show that discoveries of the earliest representatives of any group of organisms are extremely improbable. This is because numbers and diversity of organisms are certain to be very small near the time of origin. This limitation is not damaging to the evolutionist point of view.

The known record of fossils improves with accumulation of new discoveries. Consequently, it is not surprising to paleontologists that "missing links" are found with fairly predictable frequency, but the creationists like to challenge every such added link and to minimize its significance.

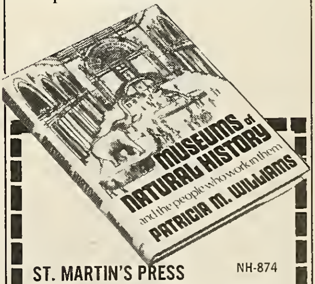
Mr. Springstead is in error about the fossil record. The oldest examples of several phyla of invertebrate animals are now known in Precambrian rocks of Australia and elsewhere. The earliest examples of major "kinds" of vertebrates appear much later and they are scattered through the stratigraphic record. There is no tendency for all or even many major groups first to appear together in concert as expected and claimed in some of the creationist literature. □

The inside story of how museums work.

"An excellent means of informing young people of the variety of careers available in museums...Drawing on twelve years of professional experience at Field Museum, the author has created a concise, nontechnical, and humanistic picture of museum people, past and present."
—*Field Museum Bulletin*

For the youngster thinking about a museum career, or for the dedicated museum goer of any age, this exciting book makes an ideal gift. Use the handy coupon below to order.

MUSEUMS OF NATURAL HISTORY AND THE PEOPLE WHO WORK IN THEM
Patricia M. Williams
Contains state-by-state listing of museums.
Illustrated with photographs.
$5.95 at all bookstores or from the publisher direct.



ST. MARTIN'S PRESS NH-874
175 Fifth Avenue, New York, N.Y. 10010
Send me, postage paid, ______ copy(ies) of MUSEUMS OF NATURAL HISTORY @ $5.95 each. I enclose $______ ☐ check ☐ m.o.
Name ______
Address ______
City ______
State ______ Zip ______

Disappearance of the Historic

Part of New York's heritage vanished when bulldozers dug the foundation for the World Trade Center

Most modern cities were created over centuries. Beginning with shacks and dusty footpaths, they have evolved into masses of concrete, steel, and glass. In the complex transformations, buildings are torn down and streets torn up, only to be replaced by newer versions. There is a constant process of decay and renewal. As it changes, the city invariably leaves part of its past in the earth. Layer upon layer, the city builds upon the past and in the process occasionally discovers its historic origins.

In 1913, construction crews, made up mostly of Italian immigrants, began gouging out the tunnel for the Seventh Avenue line of New York's subway system south of Times Square. By 1918 the line was in operation and trains were running from South Ferry, the line's southern terminus at the tip of Manhattan, to the Bronx, some thirteen miles to the north.

But in May, 1916, the workers had only reached the site of the present-day Cortlandt Street station, less than a mile from the tip of Manhattan, when their pickaxes struck something more solid than the usually soft earth. As they hastily shoveled the soil away, they could see the partial outline of an ancient ship. The dim yellow light in the damp tunnel revealed the ship's bow, keel, and ribs protruding, waist high, from the western wall of the tunnel. A broadhead ax blade lay embedded in the badly charred oak; a cannonball, a clay pipe, and some shattered bits of blue and white pottery rested on nearby timbers.

The discovery marked the beginning of a search that surfaced sporadically during the next half century and only ended in 1967. It was a search for a key to New York City's beginnings, of which few signs remain. Except for the explorations in 1524 of Giovanni da Verrazano, the first European to enter New York Harbor, and those of Henry Hudson seventy-five years later, little is known about the activities of the early explorers here.

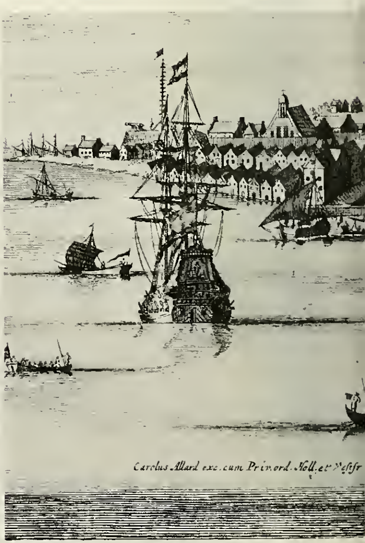
The foreman of the 1916 construction crew was James A. Kelly, a short, dapper Irishman with quick, darting eyes. Like other subway construction foremen of those days, he wore a three-piece suit with a watch chain across his vest when he was working in the tunnel. A vaudeville singer in his spare time, Kelly frequently belted out tunes to his crew, who referred to him as the "singing subway man." "They're going to dig a subway to Ireland" was the refrain of one of his favorite songs.

Intrigued by finding an old ship eighteen feet below what was then the intersection of Greenwich and Dey Streets, Kelly asked historians from various museums to examine it, hoping they would attempt to excavate it. Some of them speculated that the charred timbers might be the remains of a seventeenth-century Dutch ship, the *Tijger*, but they were not interested in excavating it. Kelly then tried to save the timbers himself. He lined up his crew along the ten-foot section of tunnel wall and ordered them to pull the timbers out. But the timbers did not budge. He then hitched several mules to the one-foot-square keel; they strained but could not move it. The failure suggested that a considerable length of the ship was still buried.

Then, as today, contracting firms placed a high priority on maintaining construction schedules and on keeping costs as low as possible. Stymied by the immovable timbers and pressured by the construction firm, Kelly decided to cut off the keel and bow at the point where it disappeared into the tunnel wall. This section, with three ribs attached, was taken to the nearby New York Aquarium and placed in the seal tank, where it became a favorite obstacle for the seals. Immersion helped preserve the find, for if the wood had been permitted to dry out, it would have soon flaked away.

When the concrete walls of the subway tunnel ended any hope of excavating the rest of the ship, Kelly seemingly lost interest in the matter. Shortly thereafter, he gave up subway construction and went into politics, where his activity led to his appointment as Deputy Clerk of Kings County. In 1943 Kelly learned that the New York Aquarium was being razed. To rescue the ship's section he had first salvaged in 1916, Kelly crawled through a window of the deserted and partially demolished building. The seal tank had been destroyed, but the falling beams and walls had just missed the still-wet timbers. How Kelly got them out of the building is not clear, but one version of the story has it that he dragged the heavy wood down the dirty and empty halls and loaded them into a rented truck. Whatever the case, the timbers were presented to the Parks Department, which gave them to the Museum of the City of New York, where they can be seen today.

Perhaps this second near loss of the timbers jogged Kelly into realizing how vulnerable they were in the face of progress. Acquaintances of


Carolus Allard exc. cum Priv. ord. Holl. et Westfr

Ship Tijger

by Christopher L. Hallowell

Kelly recall that after this rescue he expressed a great desire to have the remaining part of the ship excavated. Proud of his discovery, he grew extremely irritated if anyone belittled its significance.

It was not until 1955, however, that Kelly and the Museum of the City of New York took steps that they hoped might lead to the complete excavation of the ship. In that year, the authenticity of the timbers was confirmed when Columbia University's Lamont-Doherty Geological Observatory dated the wood as being between 320 and 360 years old. The Bethlehem Steel Research Laboratory examined an iron bolt from the ship and concluded that, because of its high carbon and low manganese content, it was probably made by a smelting process used in Europe about 1600.

The dating of the wood and the iron bolt and the location and condition of the timbers strongly suggested that the ship's remains were those of the *Tijger*, one of the first European vessels to anchor in New York Harbor.

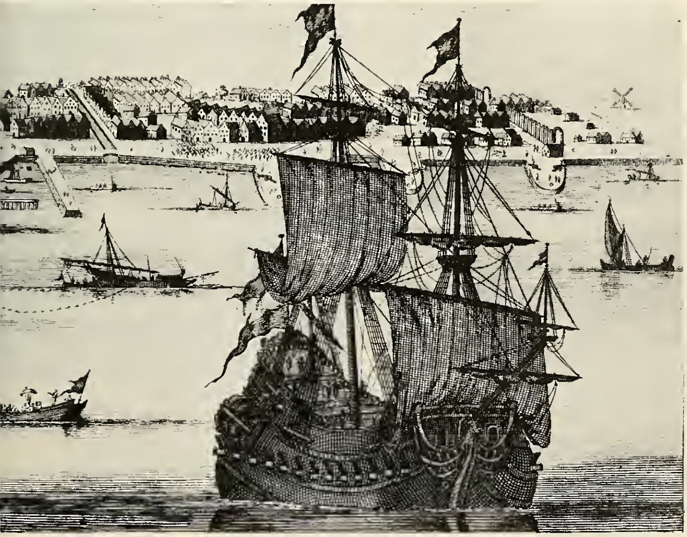
Between 1611 and 1614 about a dozen Dutch ships had sailed to the New World to exploit the abundant furs reported by Henry Hudson after his trip in 1609 up the river later named for him. On this voyage Hudson was searching for a northwest passage to the Orient. But instead of a route to the riches of the east, he found Indians who were eager to exchange beaver and otter pelts for necklaces, knives, and other small items.

Throughout the shadowy accounts of Dutch trade and voyages of the early seventeenth century, the names Adriaen Block and Hendrick Christiaensen occur frequently. Both men were traders and ship captains employed by the Van Tweenhuysen Company of Amsterdam, which dealt in pearls, wine, tar, and textiles. Sailing for the company in 1611, Christiaensen is thought to have been the first to follow Hudson to what is now Manhattan.

In the fall of 1613, the Van Tweenhuysen Company sent two ships to purchase furs—the *Fortuyn* under Christiaensen and the *Tijger* under Block. At the same time, a competing Amsterdam trading firm sent the *Nachtagael*, under Thijs Mossel, also to purchase furs. The *Tijger* was small compared to other Dutch ships of the time (it was 80 feet long and weighed some 130 tons), but typical in many ways. Square rigged, she had a broad bow, called an "apple bow," which, although not conducive to speed, gave her stability in heavy ocean swells. From her long bowsprit, her lines curved gradually back to the great beam amidships and a square stern dominated by a high poop deck. In addition to a crew of about eighteen men, she carried six or possibly eight 1,500- to 1,600-pound cannons loaned by the Admiralty of Amsterdam. Although there is no record of other ships being so armed, Block probably carried the cannons for protection against pirates and French and English privateers.

Throughout the last months of 1613 and into 1614, Block and his men bought furs from the Indians on Manhattan, gradually filling the roomy holds of the *Tijger*. The southern end of the island bustled with activity, as Indians and Europeans haggled over prices. Every day more Indians arrived, having paddled or walked for miles carrying their furs for Block and his men to view. As Block ran his eye over each skin and felt it to test its quality, his men stood by in case an Indian should feel cheated by the exchange of cheap trinkets for a prime beaver pelt.

By the end of January, 1614, the *Tijger* was fully loaded and ready to depart for Holland. Just as she was about to weigh anchor, a fire started on board, sweeping through the ship in minutes. Her crew scrambled to safety in dinghies before the



THE NEW YORK PUBLIC LIBRARY

By 1673 settlers had built a fort (left) at the southern tip of Manhattan. The Tijger's *design was probably similar to that of the ship at right.*

ELEGANT SIMPLICITY FOR THE HOME OR OFFICE, OR AS A PERFECT GIFT IDEA

BONSAI Hardy, Beautifull Imported from Jepen.

A living miniature tree. Twenty-years old complete in its own stoneware planter, with instructions on care. These amazing values come to you from Heirob Bonsai Nursery, America's largest importer of Bonsai trees.

12" Japanese Pine, 10" Japanese Cedar, 12" Japanese Juniper, 10" Japanese Flowering Quince or 8" Blue Moss Cypress **$34.50** each/**$66.00** for two/**$150** for all five, *delivery included.*

We Ship to Canada

HEIROB BONSAI NURSERY
Willowemoc Rd., Livingston Manor, N.Y. 12758
(914) 439-5706 Phone Orders Accepted

☐ 12" Japanese Pine ☐ 12" Japanese Juniper
☐ 10" Japanese Flowering Quince
☐ 8" Blue Moss Cypress ☐ 10" Japanese Cedar
☐ 1 Tree @ $34.50 ☐ 2 Trees @ $66.00
☐ All 5 for $150.00 ☐ Complete Catalogue

Enclosed is my check or money order for $______ including sales tax, if any.
Bill my________credit card account for the full amount of $______. Plus sales tax, if any.
☐☐☐ ☐☐☐ ☐☐☐ ☐ ☐☐☐
Expiration Date________
Name________
Address________
State________Zip______
City________
Signature________

Cloud-Soft Travelers

Down Sox For Men and Women

Slip on a pair of these to keep your feet warm in sleeping bag or bed; as inner sox for insulated pacs or waders. Downright comfortable travel slippers. Bauer Goose Down quilted in tough, washable Nylon taffeta. **Colors:** Red, Winter Blue, Taupe, Powder Blue. Specify shoe size. Men's 4-13, Women's 5-13 and we will send a proper fit. **0123 Goose Down Sox,** pair $8.95 postpaid.

Order Today! Money Back Guarantee!
Enclosed is my check or money order for $______. (Add sales tax where applicable.)
Please RUSH my 0123 Goose Down Sox.
Men's Size______Color______
Women's Size______Color______
Name________
Address________
City________
State________Zip______
☐ Send me FREE your new color catalog of over 1000 exciting outdoor products.

Eddie Bauer®
Dept. MNH, 1737 Airport Way S., Seattle, Wa. 98124

ship burned to the waterline and sank.

From the city's appearance today, it is difficult to visualize Manhattan's buildings resting on actual earth and rock. With few exceptions, such as Central and Inwood parks, most of Manhattan has been graded, leveled, and covered with asphalt, concrete, and steel. But in the early seventeenth century, it was open fields, with some scattered forests, especially in its northern section. South of what is now Times Square, many swampy areas were drained by streams that flowed into the Hudson and East rivers, while toward the southern tip of the island, there were ravines and steep ridges.

From the scant evidence available, archeologists have learned that the Indians inhabited the northern part of Manhattan, where they cultivated maize, potatoes, and other vegetables. During the summers they lived in temporary camps along the shores of the rivers, where they netted fish and gathered clams and oysters.

Stranded after the burning of the *Tijger* in January, Block and his crew were befriended by the Indians, who helped them build shelters and provided them with game. Certain historical accounts state that after the traders had settled into their new life-style, they built a small boat, the *Onrust,* to enable them to explore the surrounding area. Some New York historians believe the *Onrust* was the first seagoing vessel built in New York Harbor from native timber. But if the fire on the *Tijger* was as sudden as the records indicate, there was probably not enough time to get vital shipbuilding equipment off the burning ship. The few axes that the crew might have been able to save would hardly have been sufficient to build a new ship from scratch.

The remains of the *Tijger,* however, may have been used to form part of a new vessel. Block and his men could have saved themselves a great deal of labor if they had been able to beach the charred hull and use some of it for the *Onrust*'s frame. Since a stream used to empty into the Hudson at the location where the subway construction crew found the *Tijger*'s bow, the stream's mouth may have formed a shallow inlet in which the crew could have worked on the new boat.

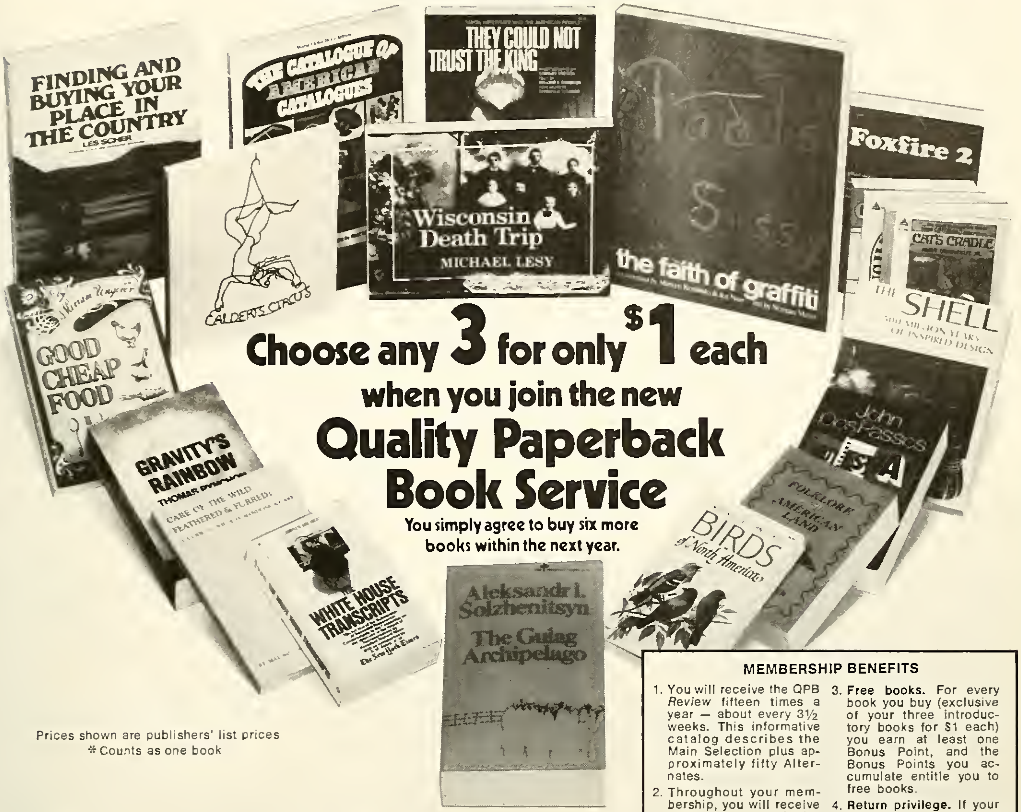
It is known that during the winter of 1614, some of Block's crew became disgruntled. In March, eight men seized the *Nachtagael* while Mossel and his crew were ashore purchasing furs. When Block realized what had happened, he and Mossel and the remaining loyal crew members ran up and down the shore firing their muskets at the raiders on the ship.

Block sent word of the ship's seizure up the river to Christiaensen, captain of the *Fortuyn,* who returned just after the raiders set sail and headed out to the Atlantic. Christiaensen gave chase but was impeded by large chunks of floating ice. When he finally got within firing range, his crew refused to fire

JAMES A. KELLY HISTORICAL INSTITUTE, ST. FRANCIS COLLEGE

Seated on the ship's timbers uncovered in the subway tunnel in 1916, James Kelly posed with a skull found by workers in another part of the tunnel.

The most readable...most portable...most affordable books around. And they're all paperbacks.


FINDING AND BUYING YOUR PLACE IN THE COUNTRY
LES SCHER
THE CATALOGUE OF AMERICAN CATALOGUES
THEY COULD NOT TRUST THE KING
Wisconsin Death Trip
MICHAEL LESY
the faith of graffiti
Foxfire 2
CAT'S CRADLE
THE SHELL
CALDER'S CIRCUS
GOOD CHEAP FOOD
GRAVITY'S RAINBOW
THOMAS PYNCHON
CARE OF THE WILD FEATHERED & FURRED
WHITE HOUSE TRANSCRIPTS
Aleksandr I. Solzhenitsyn
The Gulag Archipelago
John Dos Passos
U.S.A.
FOLKLORE ON THE AMERICAN LAND
BIRDS of North America

Choose any 3 for only $1 each

when you join the new

Quality Paperback Book Service

You simply agree to buy six more books within the next year.

Prices shown are publishers' list prices
* Counts as one book

MEMBERSHIP BENEFITS

1. You will receive the QPB *Review* fifteen times a year — about every 3½ weeks. This informative catalog describes the Main Selection plus approximately fifty Alternates.
2. Throughout your membership, you will receive a 20% members' discount on every Main Selection you accept. Higher-priced Alternates also will be discounted, sometimes even more sharply.
3. **Free books.** For every book you buy (exclusive of your three introductory books for $1 each) you earn at least one Bonus Point, and the Bonus Points you accumulate entitle you to free books.
4. **Return privilege.** If your *Review* is delayed in the mail and you receive the Main Selection without having had ten full days to decide whether or not you want it, just return the book at our expense.

7000 distinguished new paperbacks come out each year. How can you keep track of them all? You can't. But we can. We're the Quality Paperback Book Service.

We offer our members the pick of the paperbacks. Enduring fiction and nonfiction. Valuable reference books. How-to books. Art books. Modern classics. Like the paperbacks here.

And we offer a 20% saving on all Main Selections.

You won't find these paperbacks on drugstore shelves. Or at newsstands. Or even, unless you're lucky, at your neighborhood bookstore. So you've probably been missing out on a lot of rewarding reading.

But now you can have all the good paperbacks you want. Because now there's the Quality Paperback Book Service. . . . Use that coupon today.

qpb
QUALITY PAPERBACK BOOK SERVICE, INC.
Middletown, Pennsylvania 17057

150. FINDING AND BUYING YOUR PLACE IN THE COUNTRY *by* LES SCHER. $6.95

131. U.S.A. *by* JOHN DOS PASSOS *Drawings by* REGINALD MARSH. $6.50

144. BIRDS OF NORTH AMERICA *by* ROBBINS, BRUUN, ZIM & SINGER $3.95

125. THE WHITE HOUSE TRANSCRIPTS *Introduction by* R. W. APPLE, JR. *of* N.Y. Times. $2.50

109. GRAVITY'S RAINBOW *by* THOMAS PYNCHON. $4.95

140. CALDER'S CIRCUS *Edited by* JEAN LIPMAN *with* NANCY FOOTE *Circus figures photographed by* MARVIN SCHWARTZ $5.95

121. THEY COULD NOT TRUST THE KING: Nixon, Watergate, and the American People. *Photos by* STANLEY TRETICK. *Text by* WILLIAM V. SHANNON. $4.95

***132. CAT'S CRADLE, SLAUGHTER-HOUSE-FIVE** *and* **BREAKFAST OF CHAMPIONS** *by* KURT VONNEGUT, JR. Pub prices total $6.55

136. THE GULAG ARCHIPELAGO 1918-1956 *by* ALEKSANDR I. SOLZHENITSYN $1.95

108. GOOD CHEAP FOOD *by* MIRIAM UNGERER. $3.95

134. THE FAITH OF GRAFFITI *Documented by* MERVYN KURLANSKY *and* JON NAAR *Text by* NORMAN MAILER Photos. $7.95

116. WISCONSIN DEATH TRIP *by* MICHAEL LESY Photos. $5.95

106. FOXFIRE 2. *Edited by* ELIOT WIGGINTON. $4.95

145. THE CATALOGUE OF AMERICAN CATALOGUES *by* MARIA ELENA DE LA IGLESIA Photos $4.95

146. CARE OF THE WILD FEATHERED & FURRED *by* MAE HICKMAN *and* MAXINE GUY. Illustrated. $3.95

148. FOLKLORE ON THE AMERICAN LAND *by* DUNCAN EMRICH Photos. $4.95

114. THE SHELL *by* HUGH *and* MARGUERITE STIX *and* R. TUCKER ABBOTT. *Photos by* H. LANDSHOFF $4.95

QUALITY PAPERBACK BOOK SERVICE, INC.
Middletown, Pennsylvania 17057 **4-PB113-8**

Please enroll me as a Charter Member of the Quality Paperback Book Service and send me the three books whose numbers I've indicated below. Bill me only $1 for each, plus shipping and handling. Also send me the *Review* describing my first Main Selection plus nearly fifty Alternates. If I want the Main Selection, I do nothing. You will ship it automatically and bill me for it — 20% less than the regular publisher's price. A moderate shipping and handling charge is added to all shipments. If I do not want the Main Selection — or I want one or more Alternates or no book at all — I will instruct you on the convenient form enclosed with the *Review*. I will receive all future *Reviews* at approximately 3½-week intervals. My only obligation is to purchase six more books within the next year, and my membership is cancelable any time thereafter.

INDICATE BY NUMBER THE THREE BOOKS YOU WANT ☐ ☐ ☐

Mr. }
Ms. } ______________________
Please print plainly

Address ______________________ 5

0-11

City &
State ______________________ Zip ________

on their fellow mates, and he was forced to turn back.

Free of pursuers, the *Nachtagael* headed for the West Indies to join the pirate fleets that were preying upon Spanish ships returning from Mexico and South America with gold and silver and on the British ships sailing to Jamestown. According to one of the crew members, who had been impressed into sailing on the *Nachtagael*, the ship sailed the Caribbean for several months. Then it returned to Manhattan, where the crew spent three weeks on repairs before setting sail for Spain. When the ship inadvertently arrived in the waters off Ireland, then a haven for pirates, the impressed seaman escaped and made his way to Amsterdam, and the ship's eventual fate is unknown.

Block and his remaining crew members are believed to have sailed the *Onrust* north to what is now Boston, then back toward the tip of Cape Cod. Meeting the *Fortuyn* on her return trip to Holland, Block abandoned the *Onrust* and joined his old friend Christiaensen.

In the years following the burning of the *Tijger*, relations between the increasing numbers of Dutch traders and the Indians deteriorated. The Dutch constructed a fort at the southern tip of the island and built wharves in both the Hudson and East rivers. The Indians, weakened, eventually retreated.

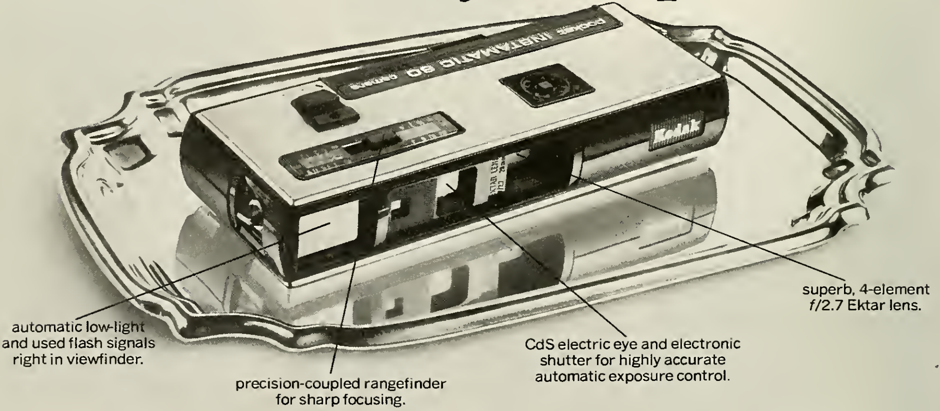
The settlers, unconcerned about preserving the environment, dumped trash wherever there was unused space, and one of the greatest expanses of unused space was the edge of the river. Modern construction sites in lower Manhattan are often full of old bottles, pottery shards, shoes, cow bones, lumber, and other miscellany, which were dumped along the shore in the seventeenth century, gradually filling it in and pushing it out.

In the latter half of the eighteenth century, however, the Hudson shoreline was given an even greater thrust outward by a landfill project, which involved dumping, in addition to earth and rocks, a great many stumps, boards, and old pilings. Today the shore of Manhattan at the mouth of the Hudson is some 200 to 300 yards west of where it was when the *Tijger* sank. But in 1916, it was the seventeenth-century shoreline the workers were gouging out when they came across the *Tijger*. Their discovery of the timbers proves that the *Tijger* was buried in silt while the remains lay either on the shore or in the shallows. But what of the remains of the remains, the approximately seventy feet of keel, ribs, and planking that were left in the tunnel wall?

On the strength of the historical accounts of the *Tijger*'s fate and the supportive analyses dating the ship's wood and iron, James Kelly and representatives of the Museum of the City of New York in 1959 tried to interest the city's political powers in a project to excavate the rest of the ship. The enthusiasm of Manhattan Borough President Hulan E. Jack paved the way for interviews and presentations before Mayor Robert F. Wagner. The museum's business manager, Lawrence Beattie, investigated the extent of the required excavation and compiled a cost estimate of $44,288. The museum and Kelly then peti-

---

Our Luxury Compact.



superb, 4-element f/2.7 Ektar lens.

automatic low-light and used flash signals right in viewfinder.

CdS electric eye and electronic shutter for highly accurate automatic exposure control.

precision-coupled rangefinder for sharp focusing.

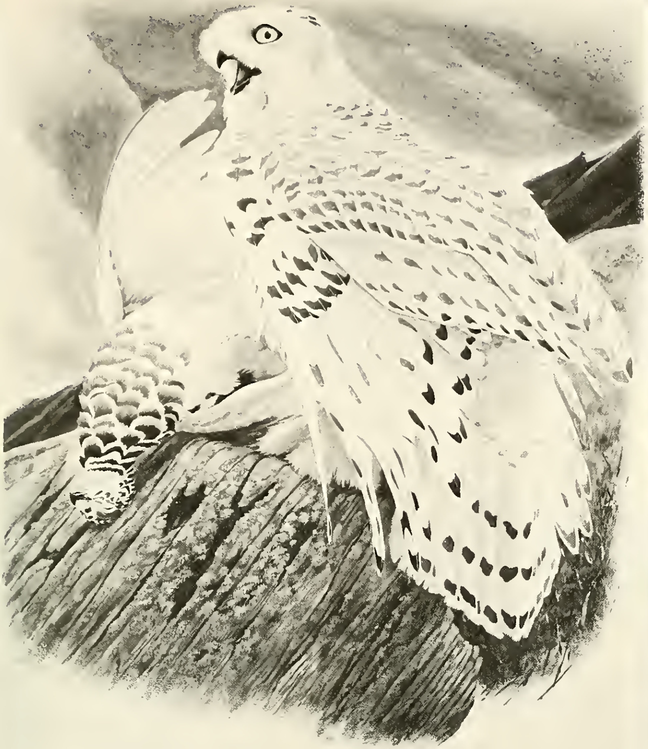
The Pocket of Pockets can be yours for less than $138. It's a sophisticated little camera, but you get all the simple conveniences, too. Like drop-in loading. And, of course, you get big, beautiful pictures. Other models, from less than $23.

Prices are subject to change without notice.

Kodak

Kodak pocket Instamatic® 60 camera.

Plate 30



(Prices subject to change without notice.)

22"x28"; edition, 5000; signed and serial numbered; $50.

Collector Prints by

Richard Sloan

Snowy Owl, an impressive predator of the northern tundra, is portrayed in full color, defensively spreading his brown-flecked wings against a green-blue backdrop of rock and sky.

Indulge---in a sound investment.

When you are buying a print to hang on the wall, liking it is reason enough. But when you are buying an heirloom to be cherished for generations, you should consider the following documented facts:

"Snowy Owl" is the 30th release in a unique collection of North American bird paintings by famed artist-naturalist Richard Sloan. In the last four years, none of the Sloan collector prints have decreased in value. Some early releases have appreciated more than 1200% of their original value. Even prints released early last year are bringing two and three times their original price.

Facts like these show why so many people like yourself are using Sloan prints to add a decorator's touch of distinction to any room.

Treat yourself to a bold, exciting piece of nature art. Treat the family to a sound investment. And remember future generations with a gift that lasts longer than a lifetime.

Write for free color brochure illustrating Sloan's latest releases.

Nature House, Box 222-TA, Griggsville, Illinois 62340

America's finest nature collector prints

Richard Sloan - considered greatest wild bird artist of the 20th Century

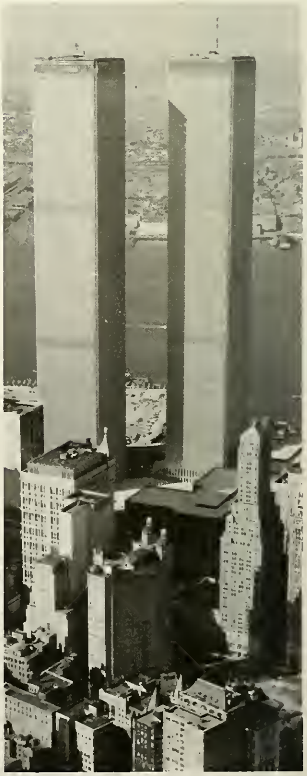
Richard Timm - this century's foremost mammal artist

Maryrose Wampler - winner of the 1974 National Flower Contest

tioned the city Board of Estimate for this amount, but the Board refused the petition, stating that the amount was excessive and that traffic in busy Globe Square, at the intersection of Dey and Greenwich Streets, would be disrupted by the excavation shaft.

If the Port Authority of New York New Jersey had not constructed the World Trade Center, perhaps nothing more would have been known about the remains of the *Tijger*. In 1966 construction began on the complex that now occupies ten city blocks. The first phase involved the excavation of a seventy-foot-deep cellar hole just opposite the spot where Kelly had cut off the *Tijger*'s bow. Those who were aware of the ship's existence believed that, with proper care, its

PORT AUTHORITY OF NEW YORK NEW JERSEY



Archeologists expected to find the Tijger*'s remains twenty feet below the plaza of the north tower, right, of the World Trade Center.*

PAINT BY SHUTTER

Couple your imagination to a Honeywell Pentax Spotmatic F. This is the 35mm camera that lets you express yourself on film, and paint by shutter. The Spotmatic F doesn't give you a lot of gimmicks to worry about. It's just pure camera, from the classic Pentax mold. So go ahead. Let your creativity and your imagination soar. Discover what millions of Pentax owners have already learned—how easy it is to create great photographs. Ask for a demonstration of the Spotmatic F at your Honeywell Photo dealer or write us for FREE literature: Honeywell Photographic, Dept. 113-522, P.O. Box 22083 Denver, CO. 80222. In Canada, McQueen Sales, Ltd., a Honeywell subsidiary.

Honeywell Pentax

*Honeywell Pentax in the U.S. and Mexico. Asahi Pentax elsewhere.

Strangely beautiful cruises to forgotten islands. Indonesia adventures. 5 to 14 days, 2 to 7 ports.

Sail from Singapore, Bali or Jakarta.

Throughout 1974, the elegant new m.s. Prinsendam weaves a magic spell to haunting places. Join her for cruises of 14, 10, 9, 7 or 5 days. It depends on how many of these exotic ports you choose: Penang, Belawan, Sibolga, Nias, Surabaya. Rates from only $375 for 5 days, from $1050 for 14 days.

Or take a tour package (23 to 34 days) with one price for air and cruise fares, hotels, meals, everything. From $2295. See your travel agent or mail the coupon. The m.s. Prinsendam is registered in the Netherlands Antilles. Cruise fares based on per person, double occupancy, subject to availability.

160-PSB-8

Holland America Cruises, Pier 40 North River, N.Y., N.Y. 10014. Tel. (212) 620-5101 or toll-free at (800) 221-6657

Please send me your 1974 Singapore/Bali brochure.

You may never want to get off.

Holland America Cruises

Name__________
Address__________
City__________ State__________ Zip__________
Travel agent__________

India makes your imagination take flight. And Air-India has flights there daily.

Wherever you journey throughout India, you will begin to feel a rhythm. A rhythm calm and stately among the cool forests and mountains of the north. A rhythm sturdy and lively in the small-town bazaars. A rhythm loud and pulsing in the cities, clear and sweet among ancient temples and palaces.

It is a rhythm of infinite variations. It is the rhythm of life. Everyone can feel it. Most can see it with their eyes. In sunrises and sunsets. In weddings and festivals. In nature and in art.

And after your journey, you can take it back home with you—the hammered brasswork of craftsmen, smooth silks and fresh, nubby cottons, jeweled ornaments for the body—all memories of the rhythms you have felt.

And what better way to travel to and from the infinite variety of India than on Air-India? You'll travel on a 747 as modern as the cities we fly to daily, Bombay and New Delhi. And you'll be treated with hospitality that has grown with the traditions of 5,000 years. You can savor the subtleties of Indian cuisine or dine on fine Continental cuisine, just as you can in all of India's tall, sparkling-new, air-conditioned hotels.

Ask your travel agent to tell you about our many tours of India that fit every taste, every purse.

Air-India can take you to and through India. And your imagination can take you from there.

AIR-INDIA
666 Fifth Avenue, New York, New York 10022

We work all day to make your night with us a dream.

timbers would turn up somewhere in the more than one million cubic yards of earth to be excavated. The nascent South Street Seaport Museum sought the support of the Port Authority, and professors Ralph Solecki of Columbia University and Bert Salwen of New York University, two archeologists with a great interest in the city's past, agreed to direct the search under the aegis of the Seaport Museum.

Construction people are, at best, leery of archeologists. Once archeologists turn up an artifact at a construction site, they not only turn construction schedules topsy-turvy but they are also enormous insurance risks. A contracting firm can lose thousands of dollars in wasted time as workmen sift through every shovelful of dirt in hopes of turning up a coin or a piece of jewelry.

To an archeologist, the essence of a discovery is not the object itself, but what surrounds the object, particularly what lies under and over it. By examining artifacts as they lie in the ground, by making sketches and taking photographs, some perspective can be gained about time sequences, usage, and the habits of the people under study. The time-consuming process of relating one artifact to another, however, makes contractors turn pale. They envision archeologists, with their brushes and sifting screens, measuring tapes and sketch pads, as having no concern for a construction firm's desire to keep costs as low as possible.

The Port Authority, however, agreed to support the initiative of the South Street Seaport Museum in the search. Finding the ship that represented New York's earliest international trade directly beneath the building housing the country's most sophisticated international trade organization would certainly be a tremendous kickoff for the World Trade Center.

This was the moment that James Kelly, then seventy-eight years old, had been waiting for. Ever since the Board of Estimate had turned down his petition seven years earlier, Kelly had complained that no one was interested in finding the rest of the *Tijger*. The discovery and rescue of the ship's bow more than half a century earlier had won Kelly a certain amount of fame and recognition. In the past he had not consistently pressed for an excavation attempt, but now he frequently mentioned that he hoped that the main bulk of the keel and ribs would be recovered before he died.

In the spring of 1967 the Port Authority summoned him to the construction site, and guided by an old subway map, he marked a large yellow X near the top of the newly laid foundation wall of the World Trade Center. Construction for the complex began with the digging of a ditch, three feet wide and sixty to eighty feet deep, which followed the perimeter of the area to be excavated for the cellar hole. This ditch was first filled with hundreds of tons of cement and steel mesh, then the cellar hole was dug, creating a huge basin.

During the excavation of the spot where the *Tijger* was thought to lie, the jaws of the heavy machinery could have bitten off a three-foot-long section of the timbers without anyone noticing. The foundation wall of the cellar hole was ten feet

Avoid the rush that so few people do, and

Order now!

CHRISTMAS CARDS

Ten different East African wildlife photos in full colour, with "GREETINGS & BEST WISHES" in English and Swahili inside. Folded once to size 4½ x 7 inches. Blanks also supplied.

1974 SOCIETY CALENDAR

Twelve pages, each with full colour wildlife photo. Size approx 9 x 12 inches. Despatched directly from East Africa to addressees.

Send for Society colour brochure.

EAST AFRICAN WILD LIFE SOCIETY
P.O. BOX 20110 NAIROBI KENYA
EAST AFRICA

Please send me the **Society** colour brochure.
Name________________
Address________________

Eight wild safaris properly tamed by British Airways.

Africa. The very word inspires fierce images of wild animals and jungles dense with 12-foot plants. We'd like you to see that Africa–from safe vantage points, of course—on your choice of eight wildly exciting but comfortably tamed African tours.

On one, you'll soar over herds of wild beasts in a private plane. On another, you'll explore vast craters and deserts in a sturdy Land Rover. Some nights you'll sleep under African stars in the finest, weather-proofed canvas tents. And you'll take thrilling close-up photos of lions, giraffes and rhinos from your lodge veranda.

So this year, consider our Africa. We've properly tamed the prices too.

Value Safari
15 days $1679—$1738. Journey through Kenya and Tanzania. With the Masai Mara Game Reserve, Ngorongoro Crater, Kilimanjaro, hotels, meals and more. Good action. Good value.

East African Wing Safari
23 days $3042—$3120. Fly over plunging waterfalls, snow-topped Kibo, crocodiles and hippos in a 3-engine private plane. Hotels and meals included.

Famous Lecturer Safari
23 days $1691—$1801. Explore East Africa's fascinating wildlife with world-famous experts on our Big Game & Birds Safari. Or mix in a little Beach & Treetops or Nyeri & Treetops Safaris. All with lodgings and meals, naturally.

Trans Africa Safari
57 days $1863—$1972. Modern Land Rovers and an AfrikaBus speed you through the Sahara Desert in Algeria down to Nairobi on an eight-week journey you'll never forget. Too much to talk about here. We also have a month-long safari through Kenya and Ethiopia and two other African Safaris in this group. At relatively modest prices.

Call of Africa Safari
22 days $2239—$2300. Kenya's famed game reserves and Treetops Hotel, South Africa's National Parks, Rhodesia's Victoria Falls and the Serengeti Plains in Tanzania. All combined with meals, hotels and everything you can think of.

Africa Under Canvas Safari
21 days $2387—$2465. Explore Kenya's parks, game reserves and more, alternating your nights between comfortable lodges and sleeping outdoors in attractive campsites. For purists only.

African Sasafari
21 days $2800—$2861. A flying safari in private planes to the great wild game areas of East Africa, frontier Botswana, Mozambique, Rhodesia and South Africa. Comfortable tent camps and tree lodges. Kenya's famous Treetops. Lodgings and meals, of course.

East African Wild Life Society Safaris
21 days $2198—$3575. (Including membership.) A series of highly unusual safaris sponsored by this well-known society. Leading animal experts escort you gorilla stalking, hiking, and show you unusual game parks. Special departures for artists and photographers.

Tour prices shown are for each of two in minimum hotel category. Tour prices include 14/45 day economy excursion fare, 22/45 day economy excursion fare or 14/21 day Group Inclusive Tour fare, from New York. Subject to minimum 15 passengers. Bookings must be made at least 15 days prior to departure. Surcharges for weekend travel and supplemental charges for individuals travelling alone.

For more on how we've tamed the wild African tour, call your Travel Agent or British Airways for dates, prices and details. Even on Safari, you'll find we take good care of you.

British Airways
Box VC10, Department 151A-1540.
New York, New York 10011. Tel: (212) 687-1600.

I'd like more information on your wild but properly tamed safaris. Please send me the following brochures.

☐ Value Safari ☐ East African Wing Safari
☐ Lecturer Safari (On Safari) ☐ Trans Africa Safari
☐ Call of Africa ☐ Africa Under Canvas Safari
☐ African Sasafari ☐ East African Wild Life Society Safaris

Name ____________________

Address ____________________

City __________ State ______ Zip ______

My Travel Agent is ____________________

We'll take good care of you to Africa. Europe. The World.

British airways

BOAC and BEA

west of the IRT subway wall. and since the area between the two walls was never excavated, ten feet of the *Tijger*'s timbers could have remained buried there. This section was now gone forever without any effort to excavate it, but it was assumed that at least sixty additional feet of the ship lay just on the inner side of the foundation wall.

The Port Authority of New York New Jersey made good on its offer to support the search by allocating $20,000 for a large shaft to be dug by hand under the spot Kelly had marked on the wall. If the timbers were there, shovels would not damage them as much as bulldozers. As the workmen shoveled dirt out of the deepening hole, there were high expectations that they would strike wood at a depth of twenty feet, the approximate level at which the bow had been found.

As expected, at the twenty-foot mark, the workmen turned up pieces of wood. One piece was between six and eight feet long, according to Jim Hastie, a superintendent who was working in and around the shaft. Other pieces were broken and twisted; none of them looked as if they had ever been part of a ship. Of course, not every ship's timber looks like a ship's timber, especially if it has been buried for 350 years. Thinking that the wood was probably part of an old wharf, the workmen threw the pieces into a dump truck and hauled them away.

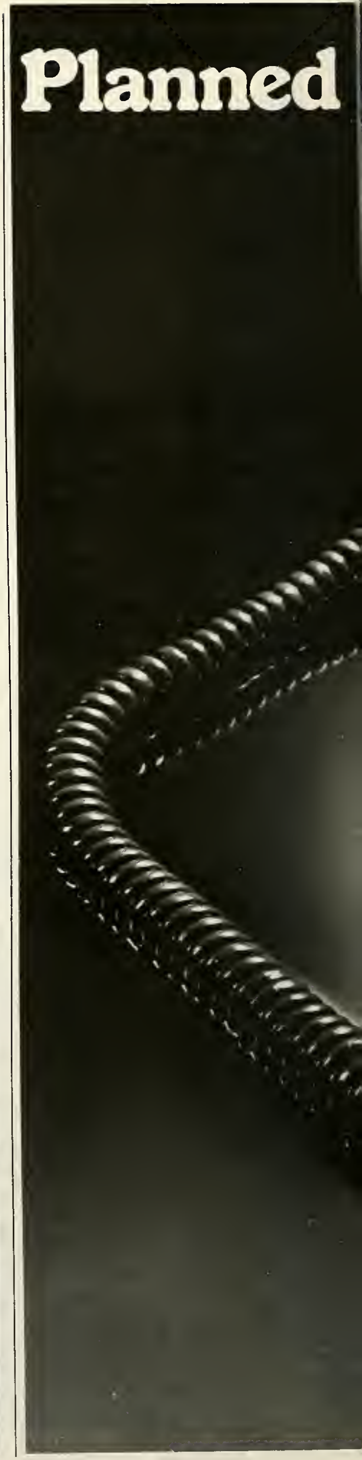
The shaft was dug without the advice of Solecki, Salwen, or George Demmy, the Seaport Museum's staff archeologist. Henry Druding, then the Port Authority's senior resident engineer, who supervised the excavation, claims that nothing was found in the hand-dug hole except a goat horn and an oyster shell.

Druding's avocation is collecting bits of information about New York City's past. He sees himself as someone who collects "useless nuggets of information—it takes away the burden of seriousness from what you're doing." As a result of his penchant for collecting, Druding rescued many artifacts at the World Trade Center site from the jaws of a steam shovel or the blade of a bulldozer. These were mostly old bottles, shoes, pottery shards, and animal bones, but some cannonballs and parts of cannons were found as well. Druding was also responsible for finding almost in the center of the cellar hole an anchor with a ten-foot shank and a ship's rudder more than six feet high in perfect condition. The anchor is now rusting

New York's first subway line, which opened in 1904, ran from Brooklyn Bridge north to 14th Street. Thousands of Italian immigrants worked at hewing out the tunnels.

NEW YORK TRANSIT AUTHORITY

Planned



un-obsolescence.

DEF
ABC
GHI 4
JKL 5
MNO 6
PRS 7
8
9
0
OPERATOR
1
AREA CODE 311
555-2368

Your phone is built to last…and last. Bell System phones are designed and built to withstand "torture tests" equal to 20 years average use. Of course, you may not need your phone that long because you'll move, or want to get a newer model.

Also, the phones we collect, we recycle. Practically nothing goes to waste.

The Bell Telephone Companies know you want a dependable, reliable phone.

We hear you.

FLY THE AFRICAN EXPRESS.

It's New York to Dakar non-stop.
It's the greatest way to the last great continent.
It's Air Afrique. The African airline that knows Africa best.

Air Afrique's African Express jet adventures-off from Kennedy every Saturday at 6 P.M. Its destination: Dakar, and then on to Robertsfield/Monrovia, Abidjan, Lome, Douala, Libreville, and Kinshasa.

But Africa begins in the sky on Air Afrique. Our food is the finest African cuisine. Our stewardesses are dressed in magnificent native fabrics (one of Africa's finest arts). And our friendship is just a hint of what you'll find when you land.

Discover Africa. Our coupon can bring you closer. Our African Express can bring you there.

AIR AFRIQUE
Air France, General Agent. Box DC8
New York, N.Y. 10011
Please send me information about
Air Afrique's Africa immediately.
Name__________
Address__________
City__________State__________
Zip__________Phone__________
Travel agent__________
Or call any Air France office. RK-NH-8-74

Air Afrique's fleet now features DC-10's clean-powered by General Electric jet engines.

away in the bowels of one tower of the World Trade Center while the rudder is flaking away on the seventy-third floor of the other tower. No effort has been made to preserve either.

Druding was responsible for the proper laying of the foundations of the world's tallest buildings. Despite his interest in the evidence of the past that was turned up in the cellar hole, he was too busy to examine every object that was dug up, especially nondescript pieces of wood, a not unusual find. Although the wood in the hand-dug shaft did not appear to have been part of a ship, it was found where the *Tijger* was thought to lie, a strong recommendation for investigation. Yet it was discarded without inquiry. The archeologists who were supposed to have directed the excavation project were never consulted. Informed only a short time ago about the find, Solecki disappointedly remarked that for a cost of $110 the wood could have been analyzed and dated.

The pieces of wood found in the shaft in the cellar hole were inconclusive: mere hints of the presence of the *Tijger*'s remains. But a few months later, hopes were raised by a discovery about 100 yards to the south of the shaft. As the bulldozers scraped away a twenty-foot-thick layer of landfill and silt, they hit a bed of sand that had probably been a beach in the early Dutch period. Lying in and on the sand were a number of ships's ribs and other timbers. The heavy machinery exposed more and more of the sand bed that Adriaen Block might have walked upon in 1614. Then a keel was uncovered. Using shovels, workmen scraped away the earth and discovered ribs attached to the heavy timber, followed by some charred planking attached to the ribs by trunnels.

The workmen unearthed about twenty-five feet of the remains of a ship. At first, there was specualtion that at last the *Tijger* had been found, but as they shoveled away the earth, it became evident that the keel was only eight inches square, smaller than that of the timbers uncovered in the subway tunnel. The discovery of the remains of a bow attached to the keel proved that the timbers were not those of the *Tijger*. Thus James Kelly's last wish never came true before his death in 1972.

Meet some delightful beasts

There's an enchanting and enchanted world awaiting you . . . a world where fierceness is not cruel, and gentleness no sign of helplessness. A natural world where animals live as nature meant them to. Come meet them in the books of the **Natural Science Book Club.** And venture further: delve into man's past and perhaps his future . . . discover odd corners of science that are sometimes astounding, always fascinating. Great books to read. All at important discounts. See for yourself.

The Cheetah
GOLDEN SHADOWS, FLYING HOOVES BY GEORGE B. SCHALLER
A Natural History of GIRAFFES

Take any 3 books for only 99¢ each

(values to $44.90)

as a member of the

Natural Science Book Club

if you will join now and agree to accept only 3 more books—at handsome discounts—within the next 12 months.

87230. WILD RIVERS OF NORTH AMERICA. *Michael Jenkinson, illustrated with photographs by Karl Lernberger.* In this text, two veterans of many river voyages offer an exciting new guide to river running, show exactly how to go about it, what to bring, and where to obtain essential river information. **$12.95**

85890. A VOICE FOR WILDLIFE: A Call for a New Ethic in Conservation. *Victor B. Scheffer.* This is a poetic, philosophical plea for decency to animals. It makes a strong case for the implementation of a new wildlife ethic — one based on moral as well as pragmatic reasons. **$7.95**

47100. EXPERT'S BOOK OF FRESH WATER FISHING. *Steve Netherby.* In this handbook, the nation's fishing experts teach you all you need to know to become a first-rate fisherman — from how to select the proper rod, reel, and tackle to how to strike, play and land a fish. **$9.95**

58440. THE LIFE AND DEATH OF WHALES. *Robert Burton.* Sensitive, engaging overview of just about everything there is to know about whales and whaling. **$6.95**

36520. THE BONE HUNTERS. *Url Lanham.* Absorbing history of the nineteenth-century adventurer-scientists who startled the scientific world, shattered many near-sacred illusions, and laid the foundations of modern paleontology. Filled with rare old photographs. **$12.95**

58611. LIFE AT THE SEA'S FRONTIERS. *Richard Perry.* Citing observations and original research from all over the world, a leading British naturalist examines the perilous, changing ecological balance of the animals and plants living at the sea's frontiers. **$7.95**

34560. ASTROPHYSICAL CONCEPTS. *Martin Harwit.* Challenging new presentation of an important new science, which bridges chemistry, physics, biology, mathematics, astronomy, meteorology, and the earth sciences. **$14.95**

50470. GOLDEN SHADOWS, FLYING HOOVES. *George Schaller.* Infectiously enthusiastic story of a leading naturalist's three-year study of the predators and prey of the Serengeti Plains in Tanzania. Highly acclaimed work contains magnificent photographs. **$8.95**

69711. THE POLAR WORLDS. *Richard Perry.* Draws a fascinating parallel between the environments of the Arctic and Antarctic and the native species which inhabit them; in Antarctica, the penguins, seals, and whales; and in the Arctic, the walruses, caribou, and polar bears. **$7.95**

62060. MEN, BEASTS AND GODS: A History of Cruelty and Kindness to Animals. *Gerald Carson.* Harrowing and revealing history of the kindness and the cruelty, the worship and the exploitation with which past and present cultures have dealt with the animal kingdom. **$8.95**

37570. CHEMISTRY FOR THE MILLION. *Richard Furnald Smith.* A highly entertaining picture of what chemistry is, what chemists do, and the significance of chemistry for the modern world. **$7.95**

56530. ISLAND AT THE CENTER OF THE WORLD. *Father Sebastian Englert.* Easter Island's mysterious giant statues, the islanders' puzzling past, their lost language — new light is shed on them all here. Lavishly illustrated in full color. **$15.00**

55030. THE ILLUSTRATED HISTORY OF MAGIC. *Milbourne Christopher.* America's foremost expert on magic has written an extraordinary history of magic. A big, beautiful book crammed with more than 300 illustrations of magicians, playbills, prints, and posters. **$14.95**

63820. A NATURAL HISTORY OF GIRAFFES. *Text by Dorcas MacClintock. Illustrations by Ugo Mochi.* If you loved artist Ugo Mochi's sensitive silhouettes for *Hoofed Mammals of the World*, you'll love this perceptive and informative study of the members of the giraffe family. **$5.95**

55561. THE INSECT SOCIETIES. *Edward O. Wilson.* "For anyone, layman or specialist, interested in a single, concise, lucid, and authoritative account of the most significant facts and theories about insect societies, *The Insect Societies* is the best available and will be for many years."—*Natural History. Counts as 2 of your 3 books.* **$20.00**

45471. ENVIRONMENTAL GEOSCIENCE. *Arthur N. Strahler and Alan H. Strahler.* The dean of American geomorphologists, ably assisted by his son (a plant geographer at the University of Virginia), explores the physical and biological processes involved in interactions between Man and the environment of energy and matter which surrounds him. **$12.95**

36141. BEYOND STONEHENGE. *Gerald S. Hawkins.* An internationally famous astronomer unravels the astronomical significance of ancient Egyptian temples, Mayan ruins, drawings in the Peruvian desert, and the huge geometrical earthworks of the U.S. **$10.00**

78390. THE SIXTH SENSE OF ANIMALS. *Maurice Burton.* A distinguished British zoologist carefully probes the scientific breakthroughs that have occurred in the past twenty-five years to convincingly argue that many animals have not five, but six, seven, and maybe even eight senses. **$6.95**

37540. THE CHEETAH. *Randall L. Eaton.* The first thrilling, exhaustive examination of this endangered species — what forces threaten its survival, and what must be done to preserve it. All the vital aspects of the beautifully spotted animal — life history, ecology, conservation, social behavior, reproduction, and captive behavior. **$12.95**

(retail prices shown)

How the Club Operates

The Book Club **News**, describing the coming Main Selection and Alternate Selections, will be sent to you 15 times a year at three to four week intervals. • If you wish to purchase the Main Selection, do nothing and it will be shipped to you automatically. • If you prefer one of the Alternates, or no book at all, simply indicate your decision on the reply form always enclosed with the **News** and mail it so we receive it by the date specified. • The **News** is mailed in time to allow you at least 10 days to decide if you want the coming Main Selection. If, because of late mail delivery of the **News**, you should ever receive a Main Selection without having had the 10-day consideration period, that Selection may be returned at Club expense. • After completing your trial membership, you will be entitled to take advantage of our fabulous bonus plan.

4-86A

Natural Science Book Club
Riverside, New Jersey 08075

Please accept my application for membership and send me the three volumes indicated, billing me only 99¢ each. I agree to purchase at least three additional books during the first year I am a member at special members' prices. Savings range up to 30% and occasionally even more. My membership is cancelable any time after I buy these three books. A shipping and handling charge is added to all shipments. **Send no money. Members are billed when books arrive.**

3 books for 99¢ each.

Indicate by number the 3 books you want.

Some expensive books count as 2 selections.

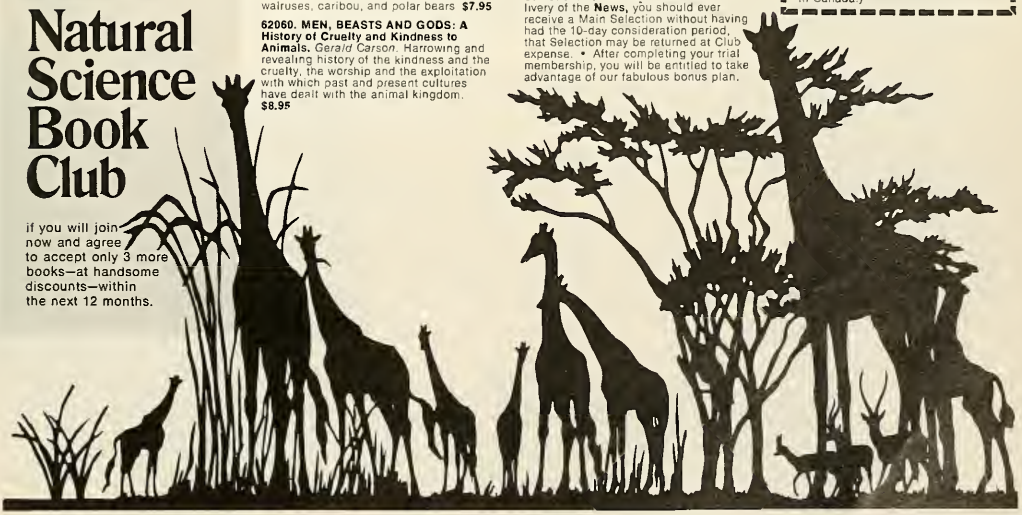
Name

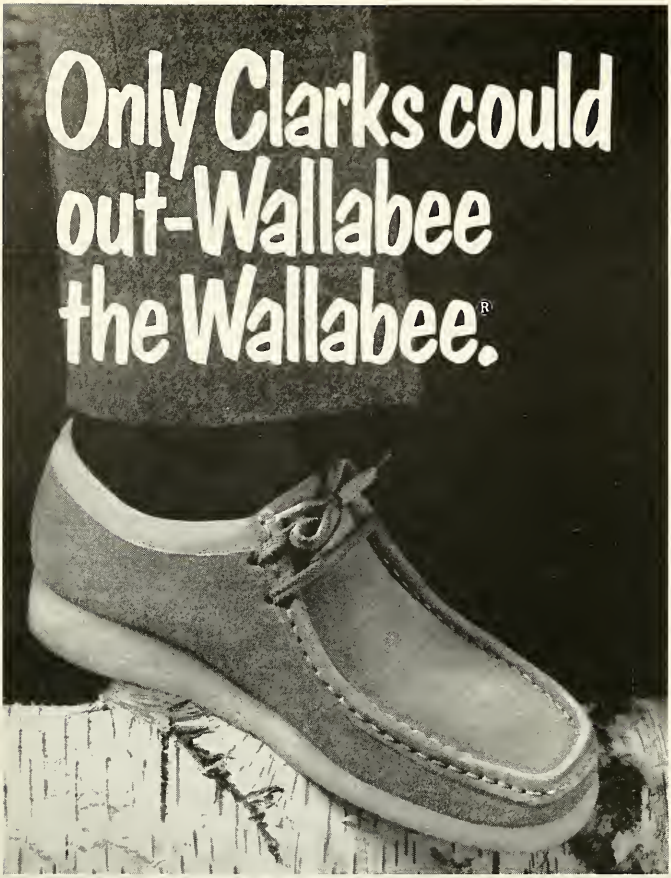
Address

City

State Zip

(Offer good in Continental U.S. and Canada only. Prices slightly higher in Canada.)





Now Wallabees are Wallabee-er than ever, with a thicker, even more generous sole. It's the same aged and toughened plantation crepe as before. There's just more of it.

That means your foot will be even more cushioned than before. There'll be more quality shoe between you and the cold hard ground.

We could have left well enough alone, but we think that if we can improve on our shoes for the sake of your feet, we will.

So we did.

The Wallabee, now with more sole than ever. Exclusively from Clarks.

Clarks®

MADE BY SKILLED HANDS THE WORLD OVER.

Available in a variety of colors. Men's and Ladies shoe about $35.00. Men's boot about $38.00.
For the store nearest you write to Clarks, Box 528, Norwalk, Conn. 06856 Dept W-1

Since the planking at the bow formed an "apple bow," characteristic of seventeenth-century Dutch ships, the approximate date of the ship could have been determined. Yet none of the archeologists involved in the project saw the remains, although they were exposed for two weeks. Druding says the timbers were without sufficient archeological value. "It [the remains] didn't appear to have any value. I didn't call Solecki because I presumed he would stop by sometime, but he didn't, so he never saw it."

The only person who took any interest in the discovery was Prof. Leo Hershkowitz, a historian and archeologist at Queens College, who acknowledges that he did not push hard enough to save the timbers. He believed they "were too large to move." Yet they were not too large for the crane that eventually snatched them up and deposited them in the back of a truck, which hauled them off as landfill for Battery City Park.

While the cellar hole of the World Trade Center was being excavated, the possibility of finding the *Tijger* was the only archeological subject of interest. With all efforts directed toward finding the *Tijger*, other artifacts were ignored, even by professional archeologists. Substantial remains of another ship of the same vintage as the *Tijger* were found and abandoned.

The conflict between saving the city's past and driving a bulldozer over it is not a new one. In the landfill that forms most of Manhattan's tip, artifacts turn up in virtually every cellar hole excavation. Small artifacts sometimes end up in private collections or in workmen's homes; large ones are discarded and usually dumped.

The city government is perhaps the only institution that could oversee the preservation of the city's past. An archeologist hired by the city to examine construction sites for archeological evidence would have the influence, as well as the inclination, to understand and save the bits and pieces of the past, so that something of the city's beginnings could be understood. Even now, as bulldozers and steam shovels smash and tear at the city's roots, the past, together with some understanding of the present, is being carted away forever. ☐

Smile . . . get a complimentary copy of psychology today and a half-price rate for new subscribers

I want a complimentary copy of Psychology Today

Please send me, without cost, obligation or commitment, my complimentary copy of the current issue. If I like it, bill me for a year's subscription (11 additional issues for a total of 12 in all) at just $6 instead of $12, half the regular price. If I don't like it I will write "cancel" across your bill, return it, and that will be the end of the matter. In either case, the complimentary issue is mine to keep.

Name________________________________
PLEASE PRINT

Address______________________________

City_________________________________

State________________ Zip________

Subscriptions outside the U. S. and Canada $2.00 higher.

8269

BUSINESS REPLY MAIL
No Postage Stamp Necessary if Mailed in the United States

Postage will be paid by

psychology today
P.O. Box 2990
Boulder, Colorado 80302

FIRST CLASS
Permit No. 740
Boulder, Colo.

This is
Psychology Today

- Why Black Males Lead in Mixed Groups
- Games Babies Play
- How Groupthink Led to Vietnam
- Success and the Mobicentric Executive
- The Importance of Daydreaming
- The Psychology of Police Confessions
- Characteristics of the Successful Investor
- Understanding Children's Art
- Can Fingers See Color?
- Criminals Can Be Brainwashed—Now
- Fantasies at Breastfeeding Time
- Teaching Chimpanzees to Read and Write
- Religious Hang-Ups
- The Screaming Cure—Does It Work?
- How to Quit Smoking
- The Masks We Wear

Find out what you're missing
Mail card for complimentary copy.

If card is missing, write Psychology Today,
Box 2990, Boulder, Colorado 80302

the most exciting postgraduate adventure today

and you don't have to have a college degree to enjoy it

*M*ost people are drop-outs. It doesn't matter whether they drop out during or after high school, or during or after college. It still adds up to the same thing. The big turn-off of the mind.

But if you're one of those rare inquisitive souls who never lost your zest for new discoveries, then we have a great adventure for you.

We want to take you to the farthest frontiers of the mind, where the Freuds, Jungs, and Pavlovs of today are making astounding discoveries about human (and animal) behavior.

YOU'LL VISIT experimental places like the home for juvenile delinquents in Kansas where a system of rewards is training them to keep out of trouble—at far less cost to the state than the usual (and unsuccessful) reform school.

YOU'LL SIT IN on today's leading forms of therapy and consciousness-expanding such as the Primal Scream. Nude Therapy. Now and How. Marathons. "No Cop-Out" Therapy. I'm O.K., you're O.K.

YOU'LL OBSERVE such fascinating laboratory phenomena as the chimpanzee named Sarah, who can compose whole sentences from her vocabulary of some 120 words.

YOU'LL STUDY successful stock market investors and learn to identity and recognize their personality characteristics.

YOU'LL GLIMPSE the dreams of geniuses like Elias Howe, who had been frustrated for many years by his failure to perfect the sewing machine. (One night he dreamed he had been captured by savages, and noticed that the rising and descending spear tips all had eye-shaped holes...)

YOU'LL GET AN INSIDE VIEW of historic events like the Berrigan trial, in which social science techniques and community surveys were successfully used by the defense attorneys to select a sympathetic jury in a conservative area.

YOU'LL TALK WITH the researchers, writers, thinkers, and dreamers in the forefront of today's culture, like Carlos Castaneda...B. F. Skinner...Herbert Marcuse...Timothy Leary...Eric Fromm...John Lilly...Margaret Mead...Bruno Bettelheim.

YOU'LL TOUR social experiments like Twin Oaks, where a dedicated group has been running a community along lines laid down by B. F. Skinner in his utopian novel, *Walden Two.*

These are the kinds of adventures that await you in Psychology Today, the monthly magazine that keeps you growing.

Traditionally, in many college subjects, you have to grind for a year or two through agonizingly dull basics before you get to "the good parts." Psychology Today is all "good parts"—the fascinating, illuminating contemporary discoveries about who we are, why we act as we do, how we can change.

Some of it is daring theory. Some is outrageous opinion. But much is startling fact and measured experiments which will rob you of some of your fondest pet notions—and provide you with powerful ammunition for your next argument with friends.

And it's all completely authentic, yet presented in a way the general reader can enjoy. Not jazzed up. Not watered down. Not clouded over with professional jargon. Straight and clear in a way that both professionals and an interested general audience can appreciate. And visually enhanced with colorful prize-winning avant garde graphics that reinforce the tingling feeling of high adventure.

Find out for yourself. Mail coupon for a complimentary copy. We'll also reserve a one-year subscription for you (11 more issues) at a special introductory discount of 50% off the regular price and invoice you for it (see coupon). But if you're not delighted with your first copy, just return the invoice without payment and ask us to cancel your reservation.

Mail coupon for complimentary copy and a chance to subscribe at half price

psychology today

P.O. Box 2990, Boulder, Colorado 80302

Please send me, without cost, obligation or commitment, my complimentary copy of the current issue. If I like it, bill me for a year's subscription (11 additional issues for a total of 12 in all) at just $6 instead of $12, half the regular price. If I don't like it I will write "cancel" across your bill, return it, and that will be the end of the matter. In either case, the complimentary issue is mine to keep.

*Name*____________________
PLEASE PRINT

*Address*____________________

*City*____________________

*State*__________ *Zip*__________

Subscriptions outside the U. S. and Canada $2.00 higher.

8269

On Heroes and Fools in Science

When we ridicule the ideas of past scientists, we usually reveal more of our weaknesses than theirs

As a romantic teen-ager, I believed that my future life as a scientist would be justified if I could discover a single new fact, add a single brick to the bright temple of human knowledge. The conviction was noble enough; the metaphor was simply silly. Yet that metaphor still influences the attitude of many scientists toward their subject.

In the conventional model of scientific "progress," we begin in superstitious ignorance and move toward final truth by the successive accumulation of facts. In this arrogant perspective, the history of science is of little more than anecdotal interest—for it can only chronicle the errors of the past and credit the bricklayers for discerning glimpses of final truth.

Historians of science have utterly discredited this model during the past decade. Science is not a heartless pursuit of objective information. It is a creative human activity, its geniuses acting more as artists than as information processors. Changes in theory are not the derivative results of new discoveries but the work of creative imagination influenced by contemporary social and political forces.

We should not judge the past through the anachronistic spectacles of our own convictions. To do so is to rip from the landscape of the past (to enshrine in our pantheon of heroes) scientists whom we judge to be right by criteria that had nothing to do with their concerns. We are foolish if we call Anaximander (sixth century B.C.) an evolutionist because, in arguing for the primacy of water among the four elements, he held that life first inhabited the sea; yet most textbooks so credit him.

Our contemporary convictions can lead us down the opposite path, too; we readily label scientists of earlier times as villains because their theories do not seem to agree with ours. Prime examples are the preformationists, those eighteenth-century scientists who are ridiculed in modern embryology textbooks for their supposed belief that a perfect miniature homunculus inhabited the human egg (although some argued for the sperm).

According to the texts, preformationists held that the embryo developed simply by increasing in size. The theory appears even more absurd when enhanced by the necessary corollary of encasement: that Eve's ovum contained a homunculus, the ovum of that homunculus contained a tinier homunculus, and so on to infinitely tiny, preformed humans.

The preformationists, the textbooks continue, must have been blind, antiempirical dogmatists supporting an a priori doctrine of immutability against clear evidence of the senses—for one had only to open a chicken's egg in order to watch an embryo develop from simplicity to complexity. Indeed, their leading spokesman, Charles Bonnet, had proclaimed that "preformationism is the greatest triumph of reason over the senses."

Our good guys of the eighteenth century were the epigenesists; they spent their time looking at eggs rather than inventing fantasies. They proved by observation that the complexity of adult form developed gradually in the embryo. By the mid-nineteenth century they had triumphed—one more victory for unsullied scientific observation over prejudice and dogma.

In reality, the picture is not so simple. The preformationists were as careful and accurate in their empirical observations as the epigene-

JOSEPH SCROFANI

sists. Moreover, if heroes we must have, that honor might as well fall to the preformationists. We would feel much more comfortable with their view of science than with the one espoused by the epigenesists.

The imagination of a few peripheral preformationists must not be taken as the belief of an entire school. The great preformationists—Malpighi, in the seventeenth century; Bonnet and von Haller, in the eighteenth—all knew perfectly well that the chick embryo seemed to begin as a simple tube and become more and more complex as organs differentiated within the egg. They had studied and drawn the embryology of the chick in a series of astute observations that matched anything achieved by contemporary epigenesists.

Preformationists and epigenesists did not disagree about their observations; but, whereas epigenesists were prepared to take those observations literally, the preformationists insisted on probing "behind appearance." They claimed that the visual manifestations of development were deceptive. The embryo is so tiny, so gelatinous, and so transparent that the preformed structures could not at first be discerned by the crude microscopes then available.

Bonnet wrote in 1762: "Do not mark the time when organized beings begin to exist by the time when they begin to become visible; and do not constrain nature by the strict limits of our senses and instruments."

Most preformationists never believed that the preformed structures were originally organized into a perfect miniature homunculus that needed only to increase in size. The rudiments existed from the first, but in relative positions and proportions that might bear little relationship to adult morphology.

Again, Bonnet in 1762: "While the chick is still a germ, all its parts have forms, proportions and positions which differ greatly from those that they will attain during devel-

THIS PICTURE from 1953 reminds us that some things have changed in Jack Daniel's Hollow. And some things haven't.

1/5 QUART
JACK DANIEL'S
Old No. 7
Tennessee
WHISKEY

Today our grain comes in trucks instead of mule-drawn wagons. But our miller inspects each load as heedfully as ever. And rejects it all if it's not up to standard. Another thing we still do is gentle our whiskey with charcoal mellowing. That's the process that accounts for Jack Daniel's unique smoothness. And even though it dates back to 1866, we're not about to change one part of it.

CHARCOAL
MELLOWED
💧
DROP
💧
BY DROP

Tennessee Whiskey • 90 Proof • Distilled and Bottled by Jack Daniel Distillery
Lem Motlow, Prop., Inc., Lynchburg (Pop. 361), Tennessee
The first Distillery placed in the National Register of Historic Places by the United States Government.

opment. If we were able to see the germ enlarged, as it is when small, it would be impossible for us to recognize it as a chick. All the parts of the germ do not develop at the same time and uniformly."

But how did the preformationists explain the *reductio ad absurdum* of encasement—the encapsulation of our entire history in the ovaries of Eve? The concept was not absurd in an eighteenth-century context.

First of all, scientists believed that the world had existed—and would endure—for only a few thousand years. One had, therefore, to encapsulate only a limited number of generations, not the potential products of several million years on a twentieth-century geologic time chart.

Secondly, the eighteenth century had no cell theory to set a lower boundary to organic size. It now seems absurd to postulate a fully formed homunculus smaller than the minimum size of a single cell. But the eighteenth-century scientist could see no reason for a lower limit to size. In fact, Anton van Leeuwenhoek's animalcules, the single-celled microscopic creatures that had so aroused the imagination of Europe, were believed to have complete sets of miniature organs.

Thus Bonnet rhapsodized about the inconceivable tininess of nature: "Nature works as small as it wishes. We know not at all the lower boundary of the division of matter, but we see that it has been prodigiously divided. From the elephant to the mite, from the whale to the animalcule 27 million times smaller than the mite, from the globe of the sun to the globule of light, what an inconceivable multitude of intermediate degrees!"

Why did the preformationists feel such a need to penetrate behind appearances? Why would they not accept the direct evidences of their senses? Consider the alternatives. Either the parts are present from the first or the fertilized egg is utterly formless. If the egg is formless, then some external force must unerringly impose a design upon matter only potentially capable of producing it. But what kind of a force could this be? And must there be a different force for each species of animal? How can we learn about it, test it, perceive it, touch it, or understand it? How could it represent any more than an insubstantial appeal to a mysterious and mystical vitalism?

Preformationism represented the best of Newtonian science. It was designed to save a general attitude, which we would recognize today as "scientific," from a vitalism that the evidence of raw sensation implied. If the egg were truly unorganized, homogeneous material without preformed parts, then how could it yield such wondrous complexity without a mysterious directing force? It does so, and can do so, only because the structure (not merely the raw material) needed to build this complexity already resides in the egg. In this light, Bonnet's statement about the triumph of reason over the senses seems itself more reasonable.

Finally, who can say that our current understanding of embryology marks the triumph of epigenesis? Most great debates are resolved with a middle position and this is no exception. From our perspective today, the epigenesists were right; organs differentiate sequentially from simpler rudiments during embryological development; there are no preformed parts. But the preformationists were also right in insisting that complexity cannot arise from formless raw material—that there must be something within the egg to regulate its development.

All we can say (as if it mattered) is that they incorrectly identified this "something" as preformed parts, where we now understand it as encoded instructions built of DNA. But what else could we expect from eighteenth-century scientists, who knew nothing of the player piano or the automated pattern-weaving machine, not to mention the computer program? The idea of a coded program was simply not part of their intellectual equipment.

And, come to think of it, what could be more fantastic than the claim that an egg contains thousands of instructions, written on molecules that tell the cell to turn on and off the production of certain substances that regulate the speed of chemical processes? The notion of preformed parts sounds far less contrived to me. The only thing going for coded instructions is that they seem to be there.

Columnist Stephen Jay Gould teaches geology at Harvard University.

TIFFEN
Hi-Trans

Tiffen can help you learn about the birds and the bees.

Tiffen makes compact high quality Hi-Trans® binoculars designed with the outdoorsman in mind. And our unique Roof Prism Optical System is of such fine quality and durability, you'll find them only where fine cameras are sold. And at a price much less than you'd expect.

Ask to see all five models of Tiffen Hi-Trans® binoculars. And from then on, no matter which pair you choose, you can get as close to nature as you want. Write for literature.

Tiffen. The binoculars with camera quality lenses.

TIFFEN
Manufacturing Corp.
75 Jane Street
Roslyn Heights, N.Y. 11577

distinctive
CHRISTMAS IDEAS

A new catalogue of unusual and distinctive presents from the Metropolitan Museum—exact copies of ancient gold jewelry, a silver lotus ladle from the T'ang dynasty, rare early American glass, a Christmas snowflake and star, needlework kits of birds and flowers from the Unicorn tapestries, the Museum's own cookbook, and the 1975 engagement calendar, *Life in America*, are only a few of this year's suggestions. ☆ Also illustrated is a festive selection of more than fifty new Christmas cards. Both presents and cards are made especially for the Museum and can be bought *only* by mail or at the Museum itself. Send the coupon below, together with twenty-five cents, for your copy of the illustrated 100-page color catalogue.

The Metropolitan Museum of Art
255 Gracie Station, New York 10028
Please send me the Museum's new catalogue of Christmas cards, 25 cents enclosed X2

*Name*__________
*Address*__________
__________ ZIP __________

The real
The disparity is shocking; our highways are lined with quick-snack delights, our supermarkets are lined with nutritious gourmet foods, yet the faces of millions are lined with hunger and despair.

There are questions that must be faced. The population of the world will increase by 3½ billion people by the year 2000—can we possibly feed them? Is there a universal nutritious food? Can we farm the sea? Are people willing to eat foods foreign to them in order to survive? Are there ways to ship and store and distribute food to cut down on spoilage? Will it ever be possible to support a constantly expanding worldwide population? Will our world leaders solve these problems in time?
Disturbing questions; but the wrong answers, or no answers at all are even worse.

artist: m. c. escher escher foundation haags gemeentemuseum the hague

The ideal
Enough.

AtlanticRichfieldCompany

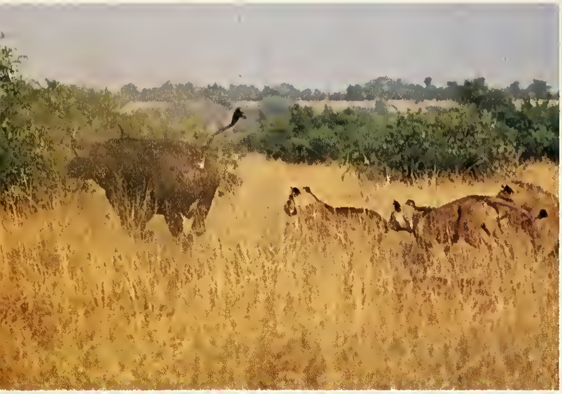
Images of a Vibrant World

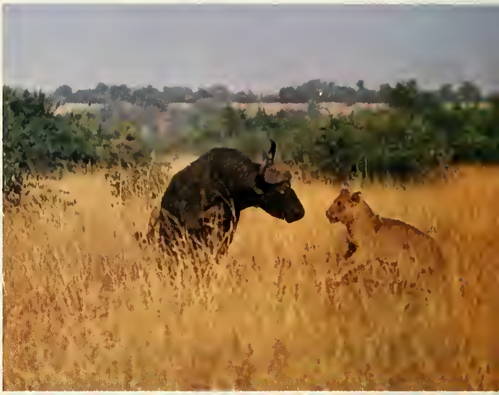
A portfolio
of winning pictures
from the 1974
Natural History Magazine
Color Photography
Competition

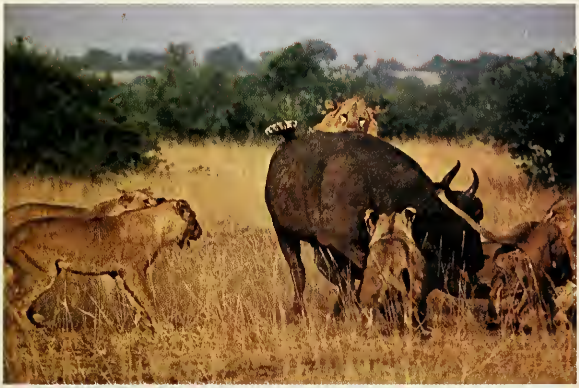
Grand Prize

Charles Steinhacker

Bull Elk, Yellowstone National Park



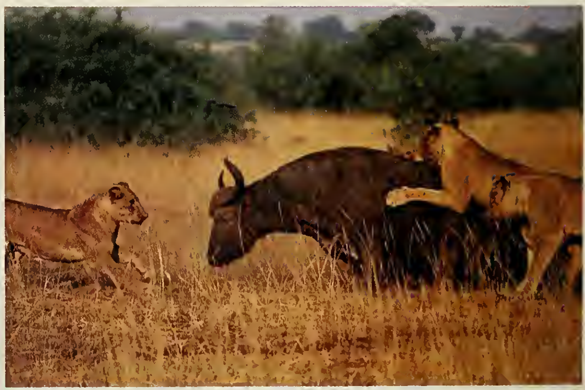




First Prize

A Chronological Sequence
of an Event in Nature

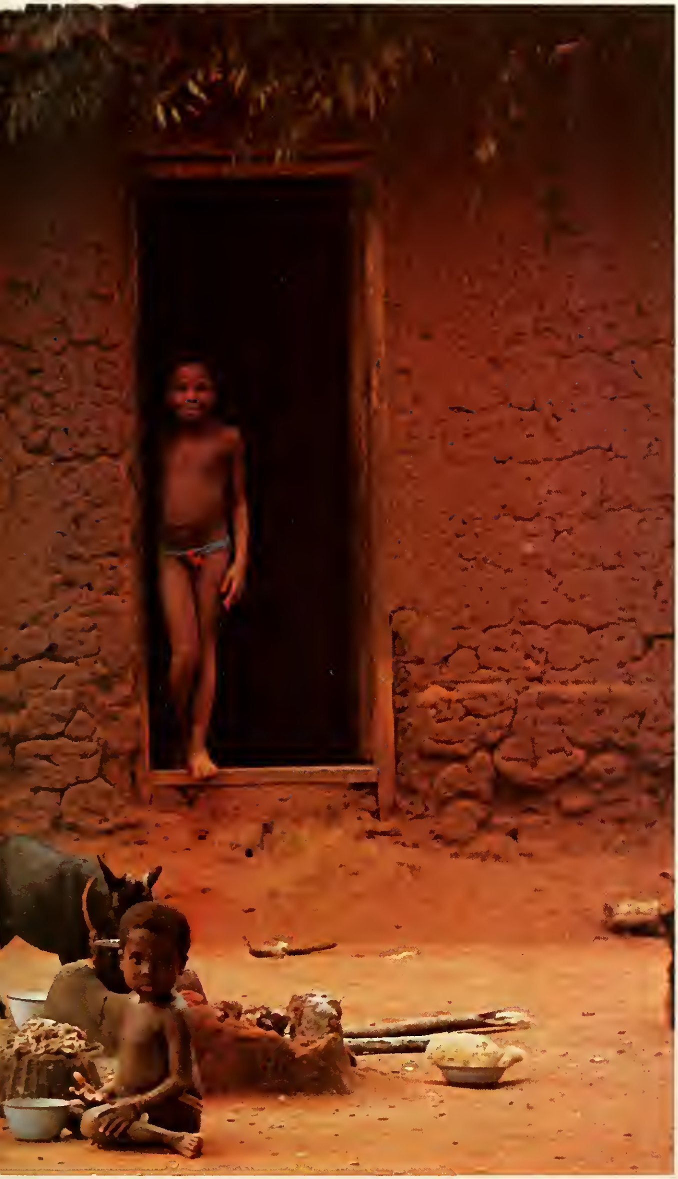
Thomas M. Ackerson



Lions killing water buffalo, Uganda

The results of *Natural History* Magazine's Color Photography Competition confirmed what many of us had sensed for a long time—that interest in photography as an art form is growing and that people everywhere are taking more beautiful and more sophisticated pictures. Last year 79,000 people in the United States studied photography; some were full-time students, planning careers as professional photographers, but most were simply individuals sensitive to their environments and anxious to learn the techniques of documenting images visually. Museums and galleries devoted exclusively to photography are opening throughout the country, and perhaps predictably, photographs are becoming an increasingly popular financial investment.

These trends were reflected in some impressive statistics from the *Natural History* competition. Between the time the contest rules were published in the February issue of the magazine and the closing date, April 15, we received nearly 30,000 transparencies. Many people sent in the full allowable complement of fifteen pictures, five for each of the three categories—The Natural World, Man and His Environment, and A Chronological Sequence of an Event in Nature. The pictures arrived in every conceivable form of wrapping and packaging:



First Prize

Man and His Environment

Frank J. Lisciandro

Family Group, Togo, West Africa

Honorable Mentions

(Continued on page 66)

Ronald A. LeMahieu
Butterfly weed seeds, New Jersey

John A. McComb
Davis Gulch, Utah

covered in tissue paper, toilet paper, cardboard. Saran Wrap, aluminum foil, or plastic from the dry cleaner's; secured in mummylike wrappings of tape; and packed into Band-Aid boxes, Sucrets' boxes, Styrofoam packets, or wooden boxes with steel springs and clasps.

More significant than the variety of wrappings was the diversity of subjects and geographical areas represented. Underwater vegetation, solar eclipses, and the sun setting over each of the six continents; close-up images of lichen and wide-angle vistas of the Pacific Ocean—the pictures formed a virtual odyssey through the natural world.

For many people, photography is a form of record keeping, a way of documenting animals, peoples, and landscapes they may never again encounter. Others, like John McComb, who received an Honorable Mention in The Natural World category, are interested in documenting areas that may themselves change. His photograph was taken in the Escalante River wilderness of southern Utah, an area continuously threatened by road, dam, and power plant projects.

Some photographers, like Ronald LeMahieu—whose picture of butterfly weed seeds was taken in the Pine Barrens, not far from his New Jersey home—look for form and beauty in familiar places. Week after week they return with their cameras to a favorite pond or beach point, learning a little more about the area, trying to interpret it with finer understanding. And Dennis Wickes was evidently intrigued by the natural processes in his own living room.

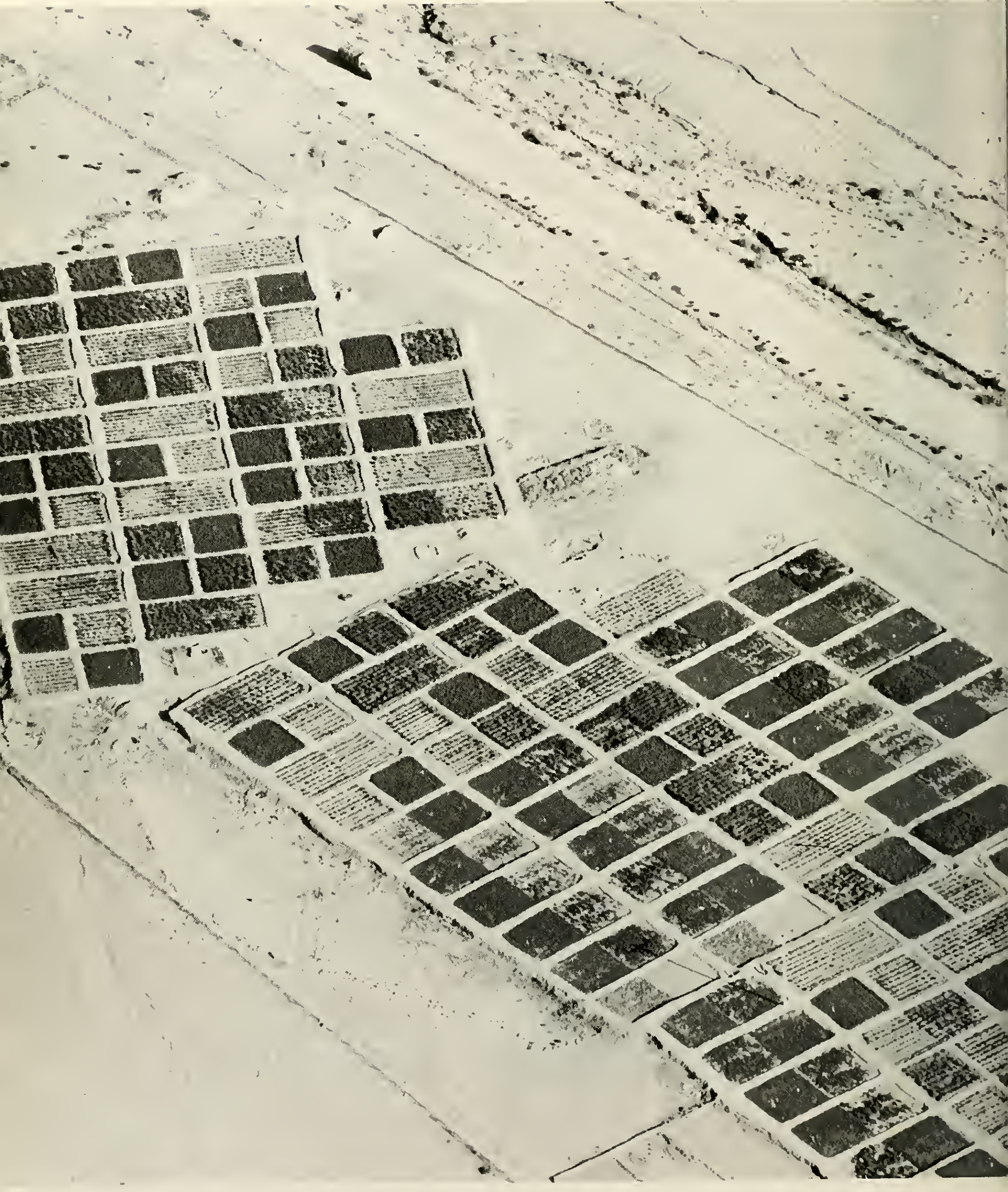
In addition to their talent, skill, and love of the natural world, some of the contestants happened to be in the right place, at the right time. Just as Roger Heath was walking away from his campsite on a river in the Sierras, he heard a loud splash. Turning, he saw a snake grabbing a rainbow trout. Josephine Cikel was not so lucky; to get her prizewinning photograph, she had to set her alarm clock at five-minute intervals so that she wouldn't miss, as she had four times before, the adult geometrid moth emerging from its chrysalis. And Thomas Ackerson spent hours watching a pride of lions, hoping they wouldn't be dispersed by the stream of Land Rovers, tour buses, and vans, until the animals finally spotted the water buffalo. The results of the encounter are recorded in his series of pictures, which won First Prize for A Chronological Sequence of an Event in Nature.

Many pictures grew out of work experiences. Grand Prize winner Charles Steinhacker was taking photographs in Yellowstone National Park for a book celebrating the park's centennial. Keith Tsubata is an undergraduate at the University of Hawaii who works part time at the Honolulu Zoo; one evening he entered the giraffe cage and took the picture that won First Prize (*cover*) in the category of The Natural World. The family pictured in Frank Lisciandro's First Prize photograph (Man and His Environment) lives in Togo, West Africa, where Lisciandro was a water-well engineer and community developer with the Peace Corps.

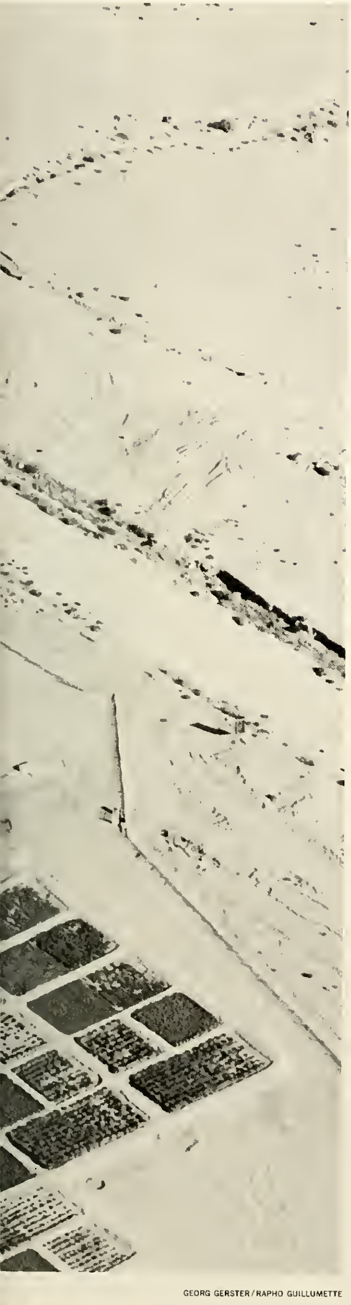
Not only were we struck by the

(*Continued on page 71*)

Desert



Farmers: Ancient and Modern



GEORG GERSTER/RAPHO GUILLUMETTE

In biblical times, the Negev Desert produced apples, peaches, barley, and wheat; after thousands of years of idleness, it may blossom again

by Michael Evenari

The Negev Desert in Israel is a triangular, arid region of some 4,600 square miles wedged between the Mediterranean Sea and the Gulf of Aqaba. It is a bleak land; its parched hills, gravel plains, and sandy expanses receive an annual rainfall of only three or four inches. Nomadic tribes have wandered the Negev for centuries. Now, modern agriculture, using irrigation, and the coming of industrial settlements are changing the nomads' desert environment.

But the Negev was not always deserted. In 1870, E. H. Palmer, the region's first European explorer, wrote,

> Long ages ago the word of God had declared that the land of the Canaanites and Ammorites should become a desolate waste; that "The cities of the south shall be shut up, and none shall open them" [Jeremiah 13:19] and here around us we saw the literal fulfillment of the dreadful curse. Walls of solid masonry, fields and gardens compassed around with goodly walls, every sign of human industry was there, but only the empty names and stone skeletons of civilization remained to tell of what the country once had been. There stood the ancient towns, still called by their ancient names, but not a living thing was to be seen, save when a lizard glided over the crumbling walls, or screech owls flitted through the lonely streets.

At an ancient farm site (partially outlined in white stones) near the old Nabataean city of Avdat, researchers are growing several varieties of alfalfa.

In 1936, an archeological expedition in the Negev discovered a collection of papyri in a ruined church in Nitzana, an ancient, deserted Negev settlement. On one papyrus was the following letter:

> Nessana [Nitzana] Village
> Elusa City District
> November 26, 569
>
> Flavius Abraham and Flavius Abu-Zunayn . . . of the camp here, and Thomas son of Awidh . . . also a soldier of the same camp, to the very estimable and very revered George son of Stephan, Recorder of the said Elusa City, greetings.
>
> May it please your Honor, on receipt of this our Communication,
>
> (1) to subtract from the total holdings of us, Abraham and Abu-Zunayn, namely that held in our father's name, consisting of 5 Kabiaiai [a measure of land]. . . . This is in virtue of the cession by us with all its rights to the aforesaid Flavius Thomas, most loyal soldier . . . of a plot of farm land situated to the south of this village. . . .
>
> (2) to register me Thomas [i.e., add on to my holdings] the said 5 Kabiaiai . . . by virtue of the cession to me with all its rights of a plot of farm land located in the section called Hither Alagrad by the aforesaid most loyal soldiers Abraham and Abu-

> Zunayn in accordance with the written deed of cession executed by them in my favor. . . .

Other papyri from the collection mention farmlands, vineyards, orchards, and water conduits. One states the yield of barley and wheat.

Today, standing in the ruins of Nitzana, high up in the Negev highlands, where the letter was written 1,405 years ago, it is difficult to believe that in this desolate, sparsely vegetated desert region there once were green farmlands, which were so important a property that any transaction concerning them had to be registered in the capital of the district by an official letter.

How could a desert with so little rainfall, an amount utterly insufficient for any normal agriculture, once have sustained crops? Evidence for the once-extensive agricultural use of the area can be found even today around the ruins of the six ancient cities in the Negev highlands, of which Nitzana is only one. The others are Avdat, Shivta, Khalutza ("Elusa" in the document), Kurnub, and Rukheibe. Many ruins of ancient farms, traces of fields, terraced areas surrounded by walls, and ancient water channels all prove that a considerable part of the land was once under steady cultivation. But in such an arid environment, agriculture would not have been possible without a sufficient water supply.

The mystery of where the water came from for ancient agriculture in the Negev can be partially solved by examining the layout of an ancient farm. Each farm consisted of two parts—the area in which crops were grown and a much larger, surrounding catchment area from which rain water was drained into the first area, thereby irrigating the crops. The growing area, usually located in a valley bottom or flood plain, was always at a lower level than the catchment.

The cultivated area was terraced, and stone walls separated each successive, lower level from the one above it. The terrace walls were built from worked stones joined without mortar. Each wall was from four and one half to six feet high and protruded above the level of its neighboring upper terrace by slightly more than a foot.

A series of steps built into each terrace wall permitted water to flow down from one terrace to the next without causing erosion. The lowest wall contained a spillway so that surplus water could flow out, and a stone wall surrounded the entire cultivation area.

The catchment area, twenty to thirty times larger than the cultivation area, was divided by a number of channels dug into its sloping sides. Whenever sufficient rain fell, the runoff collected in the channels and was carried to the terraces.

The key to the success of this method of irrigation in the Negev lies in the reaction of the soil to rain. When rain falls, the vegetation retains a certain amount of the water. Since vegetation is scarce in the desert, most of the rain reaches the ground. The soil absorbs part of the rain water at a certain rate. The rainfall not absorbed by the soil accumulates on the surface and fills surface depressions. This depression storage in the Negev desert amounts to only about one twenty-fifth of an inch of rainfall.

If, after filling the depression storage, rainfall continues at a rate greater than the infiltration rate of the soil, the accumulation of excess water on the ground flows downhill. This is the beginning of runoff. As the runoff continues, the water first flows into the smallest runnels, from there into the larger ones, and eventually, into the wadies. A desert flood thus begins.

Surface runoff is predominantly a function of the interplay between the rate of rainfall and the rate of infiltration, and the rate of infiltration is dependent upon the character of the soil. The most favorable soil for runoff farms and farming systems in the Negev highlands is composed of loess. Two qualities of loess soil enabled the ancient desert farmers to use runoff as their sole water source. When just a small amount of rain wets the loess, the colloids and very fine soil particles of the surface layer swell to form a crust that is nearly impermeable to water. Consequently, the infiltration rate decreases dramatically after this crust has been formed. Before crust formation, the infiltration rate is slightly more than one-half inch per hour. After crust formation it decreases to one-tenth of an inch per hour. All rain that falls at a rate greater than one-tenth of an inch per hour will run off instead of seeping into the ground. This is why, dependent on the rate of rainfall, 20 to 40 percent of the rainy season rainfall in the Negev highlands may be collected as runoff and conducted to the growing area.

If four inches of rain falls and if 25 percent of it runs off a catchment thirty times larger than the cultivation area, then (multiplying the amount of runoff by the area size), thirty inches of runoff water will reach the cultivation area. This means that with an actual rainfall of only four inches, the cultivation area will receive an amount of water equivalent to a thirty-four-inch rainfall. This amount of water is sufficient for any crop or orchard.

The crust-forming capacity of loess, however, is not its only advantage in runoff agriculture. The high water-holding capacity of loess makes it an ideal storehouse for water. After a flood, farm terraces may hold about a foot of water on their surfaces for a few days before the water sinks into the soil. And when it does penetrate, this quantity of water on a given area will fill the loess underneath to a depth of seven to nine feet.

After water has penetrated, the surface crust prevents it from evaporating quickly. Whereas in a year's time, four to six feet of water might evaporate from a pond or lake, an area of loess soil of equal size would lose only about one-third of an inch of water.

The last vestiges of a rainfall darken some of the runoff channels leading from a catchment area to a fruit farm. The ruins of the Byzantine city of Shivta are at the edge of the farm.

GEORG GERSTER/RAPHO GUILLUMETTE

Who were these ancient farmers who developed this agricultural system? One clue is found in the document written in Nitzana in A.D. 569. The Roman-Greek names Flavius, Valens, and Stephan, and the fact that the document is written in Greek, indicate that Nitzana was at this time part of the Byzantine empire. But what do the Semitic names Abu-Zunayn and Awidh indicate? The answer is found in tracing the historic fate of the Negev.

Many flint implements from the Paleolithic, Mesolithic, and Neolithic periods have been found in the Negev, indicating that stone age man once lived there. We may safely assume that Paleolithic and Mesolithic people were hunters and food gatherers rather than farmers. But the possibility that farming started with the Neolithic people living in the Negev cannot be ruled out; there is no proof either way. Runoff agriculture was certainly practiced in the Negev during the Israelite period about the tenth century B.C., the time of King Solomon. Terraced wadies, runoff farmsteads, cisterns, and fortresses belonging to this period have been found all over the Negev.

The Bible corroborates these archeological finds by stating that King Uzziah, ca.782-740 B.C., ". . . built towers in the desert, and digged many wells ['cisterns,' in the original Hebrew text] . . . for he loved husbandry" (II Chronicles 26:10). This period of Israelite runoff agriculture lasted three or four centuries, until the seventh or sixth century B.C. From then to about the third century B.C. there are no traces of any occupation of the Negev.

At the end of the third century B.C., however, the Nabataeans entered the desert. They were a nomadic, Semitic tribe of South Arabian origin, who became masters of the highly profitable caravan trade, transporting spices, perfumes, Chinese silks, and other luxurious goods from the Far East, India, China, and Arabia. From the east and the south, camel caravans traveled from South Arabia through present-day Jordan and the Negev to Damascus, Ghaza, and El Arish.

Seeds of a drought-resistant onion variety developed at an experimental farm will insure good yields in areas irrigated by runoff methods.

To protect their trade monopoly and trade routes, the Nabataeans built towns and fortresses at strategic sites and created settlements that became strongholds along their trade highways. Thus originated their capital, Petra, in today's Jordan, and the Negev towns of Avdat, Shivta, Khalutza, Kurnub, and Nitzana. Around these towns, the Nabataeans practiced runoff agriculture on a large scale. Nabataean farmsteads often were built upon older Israelite farms.

At its height, the Nabataean empire, or Nabataea, stretched from Hejra in Arabia to Damascus in the north and included the whole Negev. But in A.D. 106 the Romans occupied Nabataea without resistance and renamed it Provincia Arabia Petraea. The Nabataean cities and their populations remained, but they were Romanized and later Christianized when Christianity became the state religion of the Byzantine Empire, the successor of the Roman Empire.

During Byzantine rule, the Negev was of prime military importance as a buffer against the ever restless nomads of the adjoining desert. In the cities the Byzantines established garrisons made up of local residents who engaged in both agriculture and military service: Flavius Abu-Zunayn, Flavius Abraham, and Flavius Thomas of the papyrus document were both landowners and "most loyal soldiers" of the military camp at Nitzana.

During the Nabataean-Roman-Byzantine period, which lasted from about the end of the third century B.C. to the middle of the seventh century A.D., Negev runoff agriculture reached its peak of development and sophistication. But the Negev's prosperity, including its runoff agriculture, ended in A.D. 641 when the area fell into the hands of the Arabs. The cities were not destroyed, but the inhabitants slowly abandoned their homes and their fields.

The ancient farmers had mastered the desert by using the runoff system to convert inadequate rainfall into a water source sufficient for agriculture. In doing so, they at the same time conserved the environment by taming the flood torrents and preventing the damage usually produced by uncontrolled floods. Their mastery turned part of the desert into fertile agricultural land, many times more productive than the same desert became when Bedouins grazed their animals on it for 1,300 years after the Arab conquest of the Negev.

GAIL RUBIN

Could runoff agriculture be repeated today without bringing in water by pipeline from outside the Negev? In 1959, a research project in which I was involved reconstructed two ancient farm systems, one near the old city of Avdat; the other near Shivta. During the many years of surveying the ancient farm systems in the field, we had formulated a theory of how these farms had functioned. We wanted to verify this theory by experiment and also find out if runoff farming could be practical today, especially since it would exploit a source of water that presently is wasted.

This could be important considering that 95 percent of the potential water resources of Israel are already being utilized. We also hoped that by living at the reconstructed farms we would gain a better understanding of the desert and its life.

During our field work we could never rid ourselves of one lingering doubt. Some scientists believed that at the time that ancient agriculture was practiced in the Negev, the region had a higher rainfall than today and was not a desert. Although many facts seemed to disprove this theory, the final proof would be provided by the success or failure of the reconstructions. Now, we can say with certainty that at least since 1000 B.C. there has been no radical climatic change in the Negev and that it was a desert region three thousand years ago when the ancient farmers cultivated it.

In the fifteen years of our experiment, the reconstructed catchments have collected sufficient water to grow crops. If the rainfall in ancient times was greater than it is today, then the original catchments would have been smaller than they were.

After a painstaking survey of two ancient farms and their catchments, both were reconstructed. Terraces, walls, water openings, and spillways were rebuilt and the hillside channels freed of accumulated silt. In the Avdat farm a modern floodwater distribution system, including concrete channels, steel pipes, risers, and distribution outlets, was superimposed on the ancient farm system for the purpose of measuring the water-use efficiency of various cultivated plants. In both farms rain

MICHAEL EVENARI

Fruit trees in the Negev grow most efficiently when the annual rainfall is channeled into individual depressions surrounding each tree. Many harvests are above average.

gauges were put up in the catchment basins; measuring weirs and automatic water-stage recorders were installed at channel inlets to measure the runoff entering the farms from the catchments. The data collected by these many rain- and flood-gauges enabled us to analyze the rain–runoff relationship and its dependence on soil and watershed characteristics.

The rainfall during the fifteen years of our experience in the two reconstructed farms varied from just over one inch to seven inches. This variability of rainfall is a typical feature of arid regions. Each year produced at least one flood. The average runoff received from the various watersheds varied from approximately 36 to 53 cubic yards of water per acre of catchment and was always enough to keep the fruit trees, perennial pasture plants, and perennial vegetables alive even during the extreme drought of 1962–63, when growth and yield were marginal. There were four years, however, when annual field crops could not be sown for lack of sufficient water.

The aim of the agricultural program in the reconstructed farms was to find out which fruit trees, field crops, perennial and annual pasture plants, vegetables, flower bulbs, and rhizomes could be grown successfully with runoff water as the only water source.

We attempted to grow peaches, apricots, almonds, pistachios, apples, cherries, pomegranates, figs, olives, carobs, and plums, as well as grapes and loganberries. Most of the fruit trees produced average to good yields. The most promising are certain varieties of almonds and pistachios, which grow and produce well, are efficient water users, are well adapted to drought conditions, and produce high-priced fruits that are easily stored and do not spoil.

Asparagus—perennial, highly persistent, and drought resistant—is the most promising vegetable. It is also deeply rooted and develops a dense rooting system, which uses the available water efficiently.

Among the annual crops tested were wheat, barley, peas, chickpeas, onions, sunflower, safflower, garlic, sesame, cotton, and sorghum. In the fifteen-year-trial period, these crops were sown only eleven times because of drought conditions during four seasons.

The aim of the experiment with pasture plants was to select species, varieties, and types that could be used to regenerate the overgrazed pasture of the Negev and to increase its carrying capacity. Eighty-two varieties belonging to thirty-three species of perennial pasture plants were tested for survival, performance, yield, and water-use efficiency. We found that Harding grass, smilo grass, and a number of types of alfalfa are the best adapted and highest yielding under desert runoff conditions. The most efficient water user among them was wild oats. Another very successful pasture plant was the perennial saltbush, which is a valuable supplementary pasture plant for a runoff-improved desert pasture.

During our studies of the relationship between runoff and size of catchment, we found that, within certain limits, the smaller the catchment, the higher the yield of runoff water per unit surface area. Instead of one farm area with a fruit orchard receiving its runoff from a large catchment, it might be possible to give each tree its own small catchment.

In 1961, we started a microcatchment experiment. We subdivided a plain opposite the Avdat farm into a number of microcatchments, ranging in size from more than 1,000 square yards to less than 20 square yards. This was done to find out the optimum size microcatchment to yield enough water for a tree, a shrub, or any other plant we wanted to grow. Each microcatchment was surrounded by a slight earthen wall. Trees and shrubs were planted at the lowest point of each microcatchment. The experiment was a complete success; today we know that microcatchments are by far the best, most practical method for desert runoff farming because the amount of water collected as runoff can be as much as 62 percent of the rainfall. Rains that do not cause runoff on large catchments do so on the microcatchments; the amount of runoff is large enough to leach saline soils; regions that for topographical reasons are unsuited for farms can be used for microcatchments; and the cost of installing and maintaining microcatchments is very low.

After the experiments on the two reconstructed farms had proved the feasibility of runoff farming, the next step was to find out if desert runoff farming could be practically applied to large areas in Israel's Negev and in developing countries with similar deserts and rainfall. In 1970, we started a third runoff farm on a fifteen-square-mile area in Wadi Mashash, twelve miles south of Beersheba. This farm was planned as a pilot project to test runoff farming on a large scale and to serve as a demonstration and training center for desert runoff agriculture. We planted 2,000 almond, 500 olive, and 300 pistachio trees, mostly in microcatchments, using those varieties that were the most successful in Avdat. The natural pasture of the wadi was improved by eradicating the unpalatable shrub vegetation and by planting saltbushes. We also planted those perennial pasture plants that in Avdat had shown their suitability for runoff farming.

So far the microcatchments have proved their worth in Wadi Mashash in spite of its five- to six-inch rainfall. The trees grow as well as their irrigated counterparts.

Now that we know that large-scale desert runoff agriculture can be successful, opportunities can be opened in arid regions other than the Negev. Projects are now under way in parts of Africa, South Asia, and Australia. ☐

GAIL RUBIN

The Spiral Way

Of all the paths between two points, this curvaceous figure is one of the most intriguing

From microscopic marine shells to the celestial galaxies, spirals abound in nature. In geometric terms, a spiral is a plane curve that winds around a central point while moving ever farther from, or closer to, it. The figure is thus produced by the combined operations of rotation and expansion or contraction. The essential feature of a spiral is that the length of the radius vector, a straight line drawn from the center to a point on the curve, changes with the rotation. A tight spiral has a small change in its radius vector for a given amount of turning; an open spiral has a large change. The extreme example of a tight spiral is a circle, a figure produced by pure rotation in which the radius remains constant. The extreme case of an open spiral is a straight line. Here the figure is produced by pure expansion without any rotation, and the radius is infinite.

The ancient Greeks were evidently fascinated by the spiral. They incorporated it in the capitals of their Ionic columns and based many of their vases, or amphorae, on whole or partial spirals. Typically, for the Greeks, all of these man-made curves followed strict mathematical rules.

There are many kinds of spirals; their differences depend on the manner in which the length of the radius vector changes with the angle of turning. Perhaps the simplest spiral to conceive of is the one discovered by Archimedes in the third century B.C. and described in some detail in his book *On Spirals*. The best example of the Archimedes spiral is the figure produced by a sailor when he coils a rope. While each turn moves the curve uniformly farther and farther from its center, the distance between adjacent coils remains constant. In other words, the length of the radius vector is proportional to the angle of rotation. Some other examples of this type of spiral can be illustrated by the movements of an imaginary ant. The precedent for using an ant to exemplify the properties of spirals dates back to a Greek myth. According to classic legend, Daedalus, who built the labyrinth of the Minotaur in Crete, was challenged to pass a thread through the intricate spirals of a triton shell. He drilled a small hole in the closed end of the shell, fastened a thread to an ant, and put the ant in the hole. Lured by honey, the insect eventually emerged from the other end, having carried the thread through all the twists and turns of the shell.

If an ant were to move at a constant velocity outward from the center of a rotating turntable, in what it presumed was a straight line, it would actually be moving in an Archimedes spiral. The functioning of the record player is the ant trick in reverse. The pickup arm, guided by the needle, is constrained to follow the Archimedes spiral groove of the record and hence, moves from the outside inward at a uniform velocity. If an ant were trained to climb up a cone at a constant slant, its course—a conical helix—when viewed from above would be seen as an Archimedes spiral. Similarly, mountain roads that ascend at a constant inclination appear in aerial views to be such spirals.

Crystals that grow around imperfections in the orderly arrangement of their atoms, called screw dislocations, exhibit the Archimedes spiral. And it has recently been shown that ice crystals grown from brine that contains air exhibit air bubbles arranged as spirals of the Archimedes type.

The cross section of a tree trunk reveals annual growth rings, which are usually arranged in concentric circles. But in those strains of the eucalyptus tree in which the wood forms up the trunk in a turning fashion, the growth rings follow an approximate Archimedes spiral. Depending on the genetic strain, some of these growth ring spirals turn to the left, others to the right.

Electron micrographs of a cross section of developing nerve fibers in prenatal human life and in infants up to about a year old also show an

The chambered nautilus—seen here in cross section—is one of the truest equiangular spirals found in nature.

H. LANDSHOFF
FROM "THE SHELL,"
HARRY N. ABRAMS, INC.

by Gerald Oster

Archimedes spiral. This suggests that the nerve covering, or myelin sheath, is laid down like the insulation wrapped around an electrical wire. Another wrapped spiral structure in the body is the cochlea, the organ of hearing within the inner ear, which gets its name from the Greek word for snail. The cochlea is a coiled tube that discriminates high tones, particularly those enunciated in the consonants of speech. In the early stages of human embryonic development, the cochlea is straight. But as it evolves within the labyrinth of the inner ear, it adopts a curved form that achieves great compactness.

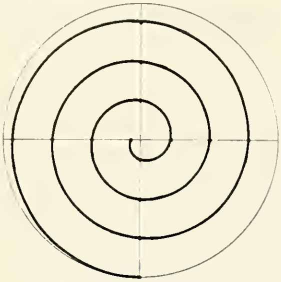
Returning to the ant climbing up the cone, if, as it nears the top, it becomes progressively more tired and takes a path of diminished slope, the spiral it describes will become tighter and tighter. If the ant's degree of tiredness follows a geometric progression, the spiral will be of the type known as equiangular. The equiangular spiral has been the subject of considerable study since the French philosopher and mathematician René Descartes first correctly defined it in 1638. In the equiangular figure, as the name implies, the spiral cuts all its radii at the same angle. The smaller that angle, the more open the spiral; conversely, the larger the angle, the tighter the spiral.

If a compulsive sea captain should stubbornly follow a fixed compass course other than due east, west, north, or south, his ship would cut the meridians at a constant angle, and the projected curve it would follow would thus be an equiangular spiral. In theory, such a course would cause the ship to spiral into either the North or South Pole. Flying ants follow an equiangular spiral trajectory when moving toward a source of light; a peculiarity of the insect's eye causes it to maintain a fixed angle of approach. A pilot will also often follow an equiangular trajectory when homing toward an airport. Strictly speaking, if the climbing and flying ants, the sea captain, and the pilot each followed a *true* equiangular spiral course, they would never reach their destinations. Destinations sought by such a course are called asymptotic poles; they can be approached but never reached.

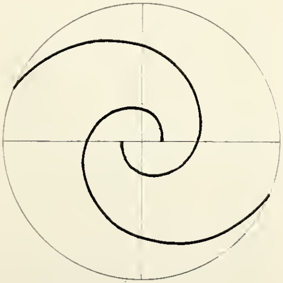
Among the special properties of the equiangular spiral is the exponential increase in the length of the radii as the curve moves away from the center. It was the Swiss mathematician Jakob Bernoulli who noted in 1698 that the logarithm of the radius is proportional to the angle of rotation. Because of its logarithmic character, the equiangular spiral is also called the logarithmic spiral. In his investigation of this spiral, Bernoulli proved that if any part of the curve is enlarged, thereby tending to flatten it, the enlarged segment will exactly match some other part of the same spiral. This invariant property—and this spiral has many others—so impressed him that he ordered that his tombstone be inscribed with a logarithmic spiral and the motto *eadem mutata resurgo*, "although changed, I always come back the same." The stonecutter got the motto right, but unfortunately he chiseled an Archimedes spiral by mistake.

The equiangular spiral expands rapidly with the rotation of the figure. With its swirling arm and exponentially expanding radius, it seems a more dynamic form than the plodding, slowly changing Archimedes spiral. There are many examples of equiangular spirals in nature: the web of the epeira spider, the scales of the pine cone, the florets of the daisy and the giant sunflower, the shoots of flowering cymose plants, the structure of hurricanes. Perhaps the most nearly perfect equiangular spiral to be found is the shell of the pearly nautilus. The chambers of this mollusk's shell increase in size in a geometric progression; the curve cuts the radius vector at an angle of 85 degrees. The shell grows larger within a fixed form, that is, it grows without a change in morphology. Given these conditions, the only shape it can take is an equiangular spiral. As with all true equiangular spirals, a magnified view of a section through the pole, or center, looks identical to the whole curve. The nautilus shell grows at one end only, and in this respect it resembles the horns of the rhinoceros and the mountain goat, which also have some spiral character.

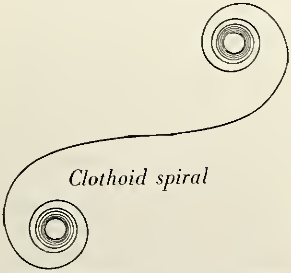
Foraminiferans, tiny organisms



Archimedes spiral



Equiangular spirals



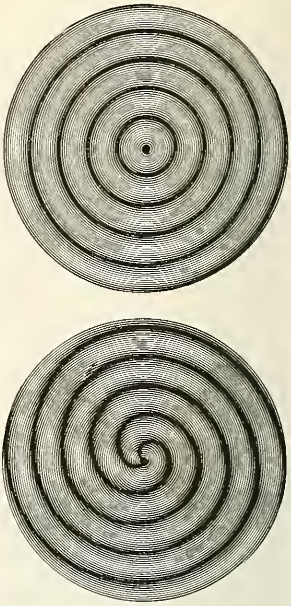
Clothoid spiral

that inhabit all marine waters, also have shells shaped like crude equiangular spirals. In fossilized form, these shells make up the material of chalk cliffs and much of the ooze on the ocean bottom. Some foraminiferan shells turn clockwise, others counterclockwise, from the apex of the shell. The direction of rotation depends on the temperature of the water at the time of the shell's growth. By studying the ratio of clockwise to counterclockwise shells in ocean bottoms, it is possible to ascertain the relative temperatures that probably existed during the Ice Age some 600,000 to 1,000,000 years ago, when these shells originally grew. Geologists have utilized the direction of coiling of foraminiferan shells in petroleum exploration to make stratification correlations between various oil wells and determine whether they are part of the same pool.

How spiral growth commences is something of a mystery. In all embryonic structures, cells are ordinarily laid down radially in the first few cleavages. The spiral character of spiral organisms is visible after the third cleavage, when 2^3, or eight, cells have been formed. The spiraling characteristic is apparently a property of the original starting cell. In that connection, it is of interest that the majority of identical twins have hair whorls that turn in opposite directions, and the same pairs of identical twins having this form of mirror imagery often exhibit reversed dental asymmetry and differences in right- and left-handedness.

Identical twins come from the symmetrical cleavage of a single fertilized egg, or zygote: they are accordingly called monozygotic. Geneticists studying such twins are learning that there are different levels of identity even among monozygotic twins. It appears that if cleavage takes place almost immediately after fertilization, before the egg has undergone much cell division, the twins will be completely identical but mirror images of each other, that is, they will have reversed hair whorls and one will be right-handed, the other left-handed. If cleavage takes place after the fertilized egg has undergone several cell divisions, the twins will not be mirror images of each other. Their hair whorls and dominant handedness may be the same. In other words, although they are monozygotic, such twins will be "less identical." The question of when, in embryonic development, such subtle genetic differences arise is not academic. It has a bearing on the important subjects of the autoimmune system and the acceptance or rejection of skin grafts and organ transplants.

The grandest of all spirals are the spiral galaxies, which measure thousands of light-years in diameter. They are clusters of stars in the form of multiarmed, crude equiangular spirals with centers at a common pole. About 50 percent of all galaxies are spirals. The form of the majority of these is the same: they are double, roughly 73-degree equiangular spirals. Our own gal-



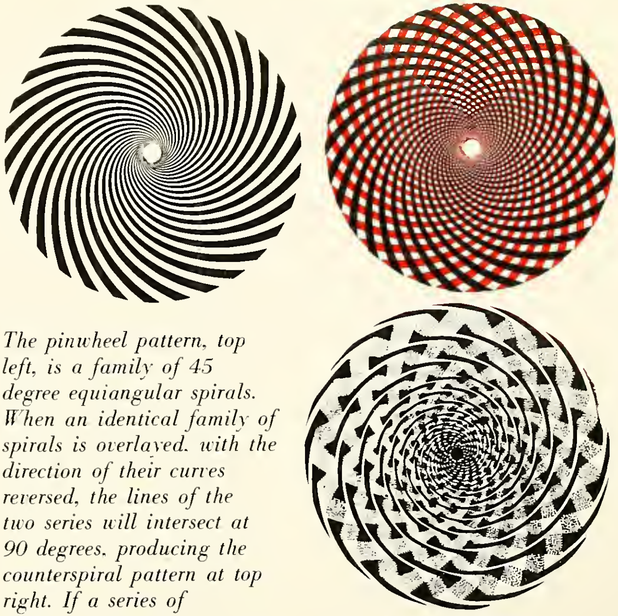
When a slightly enlarged copy of an Archimedes spiral is superimposed on the original and both curves turn in the same direction, a moiré pattern, consisting of a family of equispaced concentric circles, is produced, as in the top figure. If the direction of the overlayed spiral is reversed, as in the bottom figure, a pattern consisting of two open magnified Archimedes spirals results. Which way the moiré spirals turn depends on which of the original spirals is larger.

axy, the Milky Way, is believed to be a spiral. The earth is about 25,000 light-years, or approximately halfway, from the center, and, along with neighboring stars, rotates around it at the rate of about 150 miles per second. It was once thought that a spiral galaxy was like a rotating fireworks pinwheel, with stars being thrown out from the center. Although recent observations have disproved this interpretation, astrophysicists generally are still at a loss to explain the origin of spiral galaxies.

Such is not the case with the spiral form of hurricanes, which can be clearly seen in aerial photographs. Warm, moist air rising in the storm system and subject to the earth's rotation produces a vortex motion, which creates the spiral cloud formation. The rotation of the vortex of a hurricane is clockwise in the Southern Hemisphere and counterclockwise in the Northern Hemisphere.

Spirals, along with their counter spirals in which direction has been reversed, appear in the seed patterns of many plants. The florets of the daisy and the sunflower are arranged along sets of intersecting equiangular spirals, one of which rotates clockwise and the other counterclockwise from the plant's head. The florets increase in age and, hence, size as the curves move out from the center. In the daisy there are 21 clockwise spirals and 34 counterclockwise ones. In the giant sunflower there are usually 34 clockwise and 55 counterclockwise spirals, but the largest of these flowers may contain 89 clockwise and 144 counterclockwise spirals. The seeds of the pine cone and of the pineapple are likewise laid down as spirals: 5 clockwise and 8 counterclockwise in the pine cone; 8 clockwise and 13 counterclockwise in the pineapple.

The seventeenth-century German astronomer Johannes Kepler first recognized that the numbers of spirals in those plants are successive terms of a series called the Fibonacci sequence, named for the late-twelfth-century Italian mathematician credited with devising it. Fibonacci may have gotten his series from the Arabs.

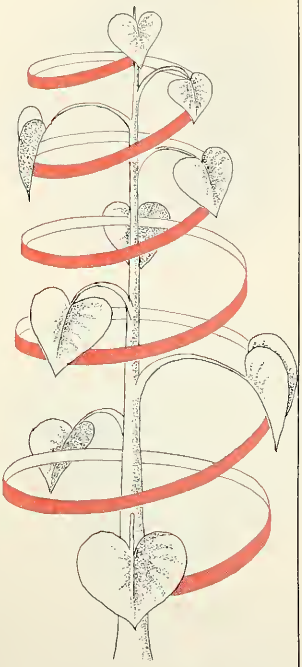


The pinwheel pattern, top left, is a family of 45 degree equiangular spirals. When an identical family of spirals is overlayed, with the direction of their curves reversed, the lines of the two series will intersect at 90 degrees, producing the counterspiral pattern at top right. If a series of concentric circles that looks like twisted rope is then superimposed on that pattern, the optical illusion of spirals receding from the surface is created, as in the bottom figure. When you trace a complete rotation of any of those spirallike curves, however, you will find they are really circles, not spirals.

The sequence results from a problem Fibonacci posed: how many pairs of rabbits can be produced from a single, immature pair in one year if it is assumed that every month each pair begets a new pair, which, from the second month, becomes productive? He learned that the number of pairs in successive months would be as follows: 1,1,2,3,5,8,13,21,34,55, 89,144 and so forth, each succeeding number being the sum of the two previous numbers. Over the years, the properties of Fibonacci numbers have been extensively studied. It has been found that the leaves on a plant, which are arranged so that the higher ones do not shade the lower ones too much, sometimes follow the Fibonacci sequence, as they wind in a conical helix up the stem. This is true of the bean plant, for example.

So far, we have described spirals in terms of how the length of the radius vector changes with the angle of turning. Spirals can be equally well defined in terms of the manner in which the amount of curvature changes as one moves along the figure. Thus, in an equiangular spiral, an arc along the curve tends to flatten out as one moves away from the center. In the circle, of course, an arc taken anywhere along the figure has the same amount of curvature as any other arc.

There is yet another kind of spiral, called a clothoid (from the Greek word for spin), which has two poles, or centers, and two arms that curve in opposite directions. In this figure, the curvature becomes tighter the farther one moves from a point midway between the poles. The clothoid was discovered in



The leaf arrangement of bean plants follows the Fibonacci sequence. The amount of turning from one leaf to the next is a fraction of a complete rotation around the stem. This fraction is a Fibonacci number divided by the successive number in the series. Moving counterclockwise from the bottom leaf to the overlapping top leaf in this illustration of a bean plant, there are five complete turns and eight spaces between the leaves. The ratio is 5:8. If the leaf arrangement were traced by moving clockwise, there would be three complete turns with five spaces between the leaves. That ratio would be 3:5.

1744 by the Swiss mathematician Leonhard Euler in connection with his work on the theory of watch springs. Each arm of the figure, often called Euler's spiral, takes the form of the mainspring of a watch, whose torque on a shaft remains constant regardless of how tightly the spring is wound.

Many individuals have hair that curves in the form of one arm of a clothoid. In cross section this type of hair is flatter than straight hair. Microscopic examination shows that one side of such hair expands more with moisture than the other side. The expansion of the moisture-sensitive side forces the hair to curl. Similarly, many developing fern fronds often take on the appearance of a clothoid arm due to the unequal growth rate of the cells at the tip of the plant.

The spiral courses followed by the climbing and flying ants, the sea captain, and the pilot are special instances of what are called pursuit problems, in which the object "pursued" is standing still. What if the pursued is moving? What course should the pursuer then follow in order to overtake or intercept the pursued? Zeno's paradox of Achilles and the tortoise is a pursuit problem in this category, as are the intuitive stratagems animals use to catch their prey. Zeno, the fifth-century philosopher, argued that if the tortoise has a head start, Achilles can never overtake it. While Achilles is moving from his starting point to that of the tortoise, the tortoise will also advance a certain distance. While Achilles traverses this distance, the tortoise will make a further advance, and so on ad infinitum. The tortoise thus can never be reached. In nature, however, the speedier pursuer more often than not does catch its slower prey.

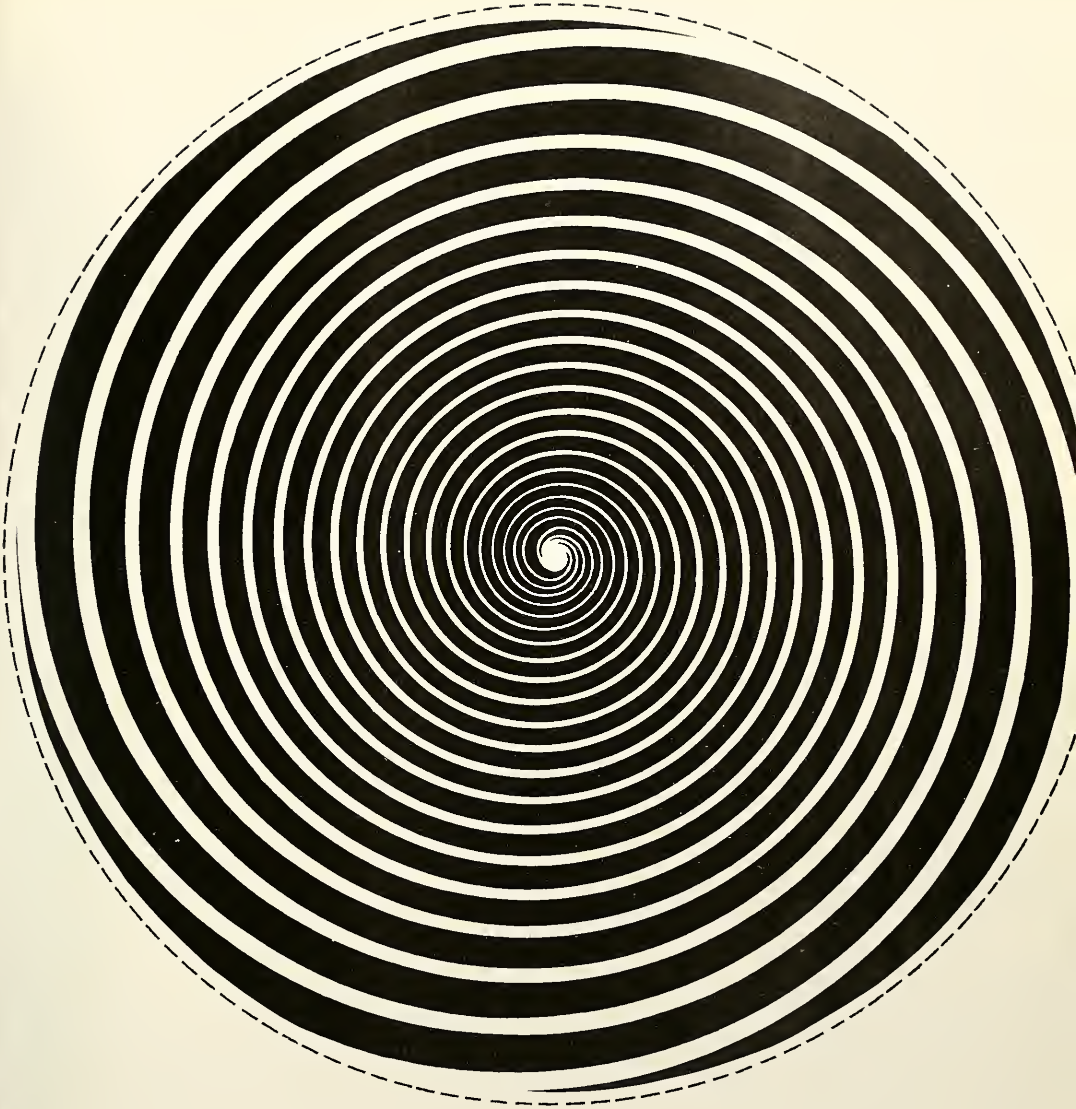
The first mathematical formulation of pursuit problems was made by Pierre Bouguer, an eighteenth-century French hydrographer. Since piracy was a serious problem in his day, he was interested in devising a strategy for the capture of the pirate vessels that were plaguing shipping to and from French colonies in the Caribbean. The most contemporary example of pursuit problems deals with the ballistics of antimissile missiles.

Many pursuit problems involve spirals. An example is the hypothetical case in which the pursued takes a circular path and moves faster than the pursuer. The pursuer, who may initially be either inside or outside the circle of the pursued, will adopt a spiral path whose curvature comes closer and closer to that of a circle concentric with the path of the pursued. In this case, the pursuer will never intercept its prey.

Another pursuit problem involving spirals is the hypothetical case in which a constant angle is unknowingly maintained between a pirate ship and a pursuing vessel. Under these conditions both ships would follow equiangular spirals whose common pole would be the point of collision.

Although appreciative of the role of spirals in nature and in the solution of geometric problems, we can be equally grateful for those instances in which spirals do not exist. In the pursuit of visual information, for example, our eyes unconsciously scan back and forth horizontally (they also do this when we dream). Imagine, however, what would happen if, when looking at something, our eyeballs moved simultaneously in an equiangular spiral manner. Due to one of the properties of that curve, that an enlarged segment matches some other part of the spiral, objects both near and far away would look the same. Thus, we would lose the important depth clue of perspective. Furthermore, our orientation would be upset and we would be unable to determine whether or not an object was tilted. Therefore, the figure of a diamond, a square tilted on one corner, would be indistinguishable from that of a square resting on one side.

In pondering on spirals, can we find an underlying generality to account for their existence from the microscopic scale of snail shells to the awesomely vast scale of galaxies? The most we can safely say without blundering into anthropomorphic or teleological philosophizing is that wherever there is outward growth or a radial force combined with rotation, a spiral is created. Meantime, spirals are here, so let's relax and enjoy them. □



Spiral Turn-on

For an interesting three-dimensional optical illusion, follow these directions: remove this page, cut around the figure with scissors, punch a hole through the center of the design, and put the cutout on a record player. Stare directly down at the design while it is rotating until the center appears to recede. Then quickly look away at anything having an irregular texture—a bath towel, a shag rug, a curly beard, a chrysanthemum, a plate of spaghetti—and you will experience a reverse after-motion that should last about 30 seconds.

Sun, Sand, and Sea Lions

A marine mammal adapted to cold water must make special efforts to deal with a hot day at the beach

by G. Causey Whittow

When the California sea lion—which inhabits the west coast of North America as far south as Mazatlán, Mexico, the Galápagos Islands, and the Sea of Japan—comes ashore to rest or breed, it may encounter conditions almost as hot and dry as those of a desert. This is particularly true when the animals haul out on the hot sand and rocks of the Galápagos Islands and the coast of Mexico. Out of the water, the sea lion's physiological adaptations to a cold-water environment—its thick layer of insulating blubber and a metabolic rate approximately double that of land mammals—serve only to prevent heat loss. Yet the capacity to tolerate a hot, dry environment is necessary to the animal's survival.

The problem of heat loss could be crucial during the breeding season, when sea lions spend much time on shore and, when the bulls especially, indulge in a great deal of strenuous activity, thereby adding to their heat load. Heat tolerance is an obvious survival factor for the species, but the mechanisms involved had never been determined. In 1968 Dr. Don T. Matsuura, at that time a graduate student in physiology at the University of Hawaii, and I began studying the responses of sea lions to a hot climate.

Our initial experiments were designed to investigate the possibility that sea lions are physiologically adapted to a hot environment. We set out to answer such questions as do they pant, do they sweat, do they, in fact, become hyperthermic in a warm environment?

We soon observed that sea lions, which usually experience a mean air temperature of 68°F., could not regulate their body temperatures in warm environments and became hyperthermic at an air temperature of 86°F., which is by no means unusual in the Galápagos. An increase in body temperature during exposure to heat, however, does not necessarily imply a breakdown of temperature regulation. In many animals, such as the camel, body temperature rises in a hot environment, permitting them to store heat in their body tissues—heat that would otherwise be lost to the environment. At high ambient temperatures, this heat would have to be lost by evaporation of moisture. Consequently, storage of heat results in a saving of water. The stored heat is eventually shed by nonevaporative means when environmental conditions favor such heat transfer, as at night when the air and ground are cooler.

The limit to the amount of heat that may be stored is set by the tolerance of the tissues to a high body temperature. Small animals reach this limit sooner than large animals, simply because a small animal has less tissue in which to store heat. Nevertheless, heat storage may provide the animal with a useful extension of the time that it is able to tolerate a hot environment.

In the course of our experiments, we obtained some indirect evidence that sea lions increase the circulation of warm blood to their skin during exposure to heat. Although this must facilitate dissipation of body heat, it is clearly not sufficient to prevent body temperature from rising. Under comfortable conditions, the sea lions breathed through their noses, but in the heat,

Spray from the breaking surf moistens and cools the skin of napping California sea lions, extending the time they can remain ashore.

TOM MYERS, TOM STACK & ASSOCIATES

In the Galápagos, sea lions spend most of their time in the water during the hottest part of the day and hall out toward evening, when the air is cooler.

NICHOLAS DEVORE III, BRUCE COLEMAN, INC.

they tended to breathe through their mouths. Unlike most terrestrial carnivores, however, they did not pant: their breathing rate remained very low, even at a body temperature of 104°F. Nor did we detect sweating anywhere on the haired skin of the torso, although we did notice what appeared to be droplets of sweat on the bare skin of the flippers.

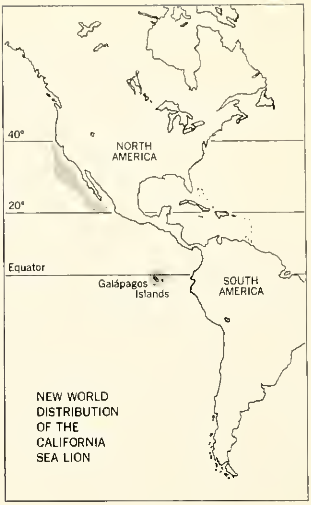
The conclusion that we drew from these early experiments was that sea lions are not very heat tolerant. Yet, several uncertainties remained in our minds. In the first place, although their breathing rate does not increase, perhaps significantly more heat is lost during open-mouth respiration than when the animals breathe through their noses. Air exhaled rapidly through the mouth is likely to have a higher temperature than air passed slowly through the nasal cavity. This is true because the surface area of the nasal cavity is so much larger than that of the mouth. The temperature of the mucous membranes of a mammal's upper respiratory tract, including its nasal cavity, is usually lower than that of the air leaving the animal's lungs. Therefore, the air cools as it passes through the nasal cavity. The greater the area of this cool surface and the more slowly the air passes over it, the greater the degree of cooling of the expired air. As the air cools, it gives up heat to the mucous membranes. This heat is retained by the animal instead of being dissipated to the surroundings. Therefore, if the sea lion bypasses its nasal cavity by breathing through its mouth, it will recover less heat from the exhaled air and, consequently, lose more heat to the environment.

The only satisfactory way of determining whether this actually occurs was to measure respiratory evaporative heat loss at different air temperatures. Our findings were that respiratory heat loss represents only 2 to 3 percent of the total heat that the animal produces in a hot environment. Consequently, respiratory evaporative heat loss is relatively unimportant in sea lions, and little benefit accrues from breathing through the mouth.

The other uncertainty was the quantitative significance of the sweating we observed on the sea lions' flippers. Also, did the total amount of moisture lost from the skin of the torso represent a significant quantity of heat, even in the absence of any evidence for the active extrusion of sweat from the glands? After all, some birds, which do not possess sweat glands, have been shown to lose a considerable amount of water from the skin during exposure to heat. The best way to resolve this problem was to measure the total amount of heat lost by evaporation from the torso and flippers. The data obtained revealed that the amount of heat lost by evaporation of moisture from the skin of sea lions in a hot environment represents only about 16 percent of the heat that they produce by metabolism.

If sea lions are unable to lose much heat to the air, perhaps they can shed metabolic heat to the sand or rocks on which they lie. This seemed worth investigating for two reasons. First, because of the nature of its appendages, a sea lion habitually has a large part of the surface of its torso in direct contact with the ground. Heat loss by conduction is, therefore, likely to be more important in these animals than in terrestrial mammals that are able to stand. Second, several species of pinnipeds—notably elephant seals and the Hawaiian monk seal—excavate shallow depressions in the sand, thereby exposing wetter, cooler sand.

Carl A. Ohata, a graduate student in physiology at the University of Hawaii, measured the heat that sea lions lost to both dry and wet sand and found that the heat loss on dry sand amounted to 10 percent of the heat produced. As expected, heat loss on wet sand tended to be higher, but the loss was limited by a physiological response to the cooling of the skin—an increase in the effective insulation of the tissues as a result of the reduced flow of warm blood to the skin.



NEW WORLD DISTRIBUTION OF THE CALIFORNIA SEA LION

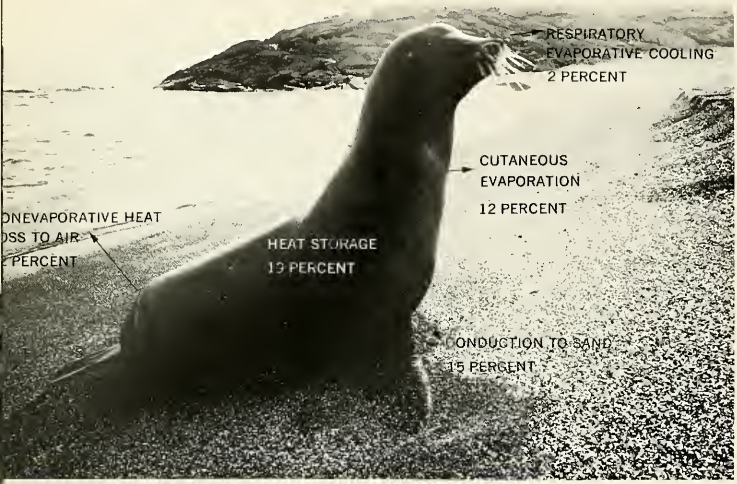
Sea lions are diving animals. It is believed that when a marine mammal dives, its metabolic rate is reduced. Suppose that a sea lion could invoke such a change in response to exposure to heat. It would be to its considerable advantage to do so, because there would then be less metabolic heat to dissipate. We tested this experimentally and found no indication that sea lions could reduce their metabolic rate in response to heat. But sea lions do go to sleep, and when they were asleep, their heat production was 24 percent less than when they were awake. Alternatively, when they become active, their heat production increases considerably.

Our experiments allowed us to compile a thermal budget for a sea lion hauled out on the sand, at an air temperature of 86°F. Of the heat that it produced, the sea lion would lose the greater part (52 percent) in nonevaporative ways. These would include conduction of heat to the surrounding air and to the sand on which the animal was lying. There would be a temperature gradient of at least 13°F. between the sea lion and the air and sand, and this gradient would pro-

Sea lions produce almost 25 percent less metabolic heat when asleep, an important reason for this type of beach behavior.

LOLA B. GRAHAM; NATIONAL AUDUBON SOCIETY

ERRESTRIAL THERMAL BUDGET FOR THE CALIFORNIA SEA LION



mote heat loss not only by conduction but also by convection. The greater the wind velocity in the vicinity of the sea lion, the more significant the convective heat loss.

In addition, heat would be lost nonevaporatively by radiation to the sand and the sky. Storage of heat in the body of the sea lion would amount to 19 percent of the heat produced, while evaporation of moisture from the skin and respiratory tract would dissipate 14 percent of the metabolic heat produced. The relatively small, separate amounts of heat lost to the sand or from the skin and respiratory tract, together with heat storage and nonevaporative heat loss to the air, would add up to a composite strategy of temperature regulation that could enable a sea lion to survive a hot day on the beach. It would have to be a cloudy day, however. Solar radiation adds considerably to the heat load with which these animals have to deal. Under clear skies on a hot day, the sea lions' tolerance time might be shortened to little more than an hour or two. If the sea lions were active, their thermal problems would be greater and their tolerance correspondingly reduced. When a sea lion first emerges from the water, evaporation of seawater removes a substantial amount of heat. If the sea lion sleeps it is very much better off, but it is unlikely that, even in these circumstances, a sea lion could endure a six-hour exposure on a warm, sunny day.

We next investigated the possibility that sea lions are endowed with behavioral mechanisms for temperature regulation. We first placed sea lions outdoors in an enclosure that was provided with a tub of water, an area of shade, and a space exposed to direct sunlight. Before beginning the experiment we fed the sea lions small telemetry capsules—radio pills—in fish. These transmitted signals, which varied in frequency with the animals' temperature. The signals were detected by an antenna, placed outside the enclosure, and a receiver. An experimenter concealed some distance away observed the behavior of the animals and measured their body temperature. The sea lions spent most of their time in the water, and their body temperatures were stable.

Next, we removed the tub of water so that the animals had a choice of only shade or direct sunlight. Although the animals chose the shady area, they did not appear comfortable and, in fact, were unable to prevent their body temperatures from rising. The sea lions were clearly heat stressed, and when their body temperatures reached 104°F., we hosed them down with water. Almost immediately, as their body temperatures began to drop, they became demonstrably more comfortable.

Finally, Carl Ohata trained the sea lions to press a small switch that turned on a shower for five seconds. They quickly learned to do this when they were hot, and once we were satisfied that they had learned how to operate the shower we placed each animal, in turn, in the enclosure, without shade or a tub of water or the switch that operated the shower. In other words, we exposed them to direct solar radiation under dry conditions.

They were obviously uncomfortable in this situation, and their body temperatures increased rapidly. The animals displayed a repertoire of behavioral responses to their heat stress. Initially, they executed fanning movements with their flippers. In view of the evidence that some sweating occurs on the flippers of sea lions, this must have been an effective means of augmenting heat loss. Later, they invariably urinated, wetting the skin on the undersides of their torsos; evaporation of the urine resulted in additional heat loss.

These behavioral responses, however, were not sufficient to allow the body temperature of the sea lions to stabilize. When body temperatures reached 104°F., the shower switch was reintroduced into the enclosure. The sea lions immediately began to press the switch and continued to do so until they were thoroughly wet. Their body temperatures decreased to between 98° and 100°F. An occasional shower permitted them to maintain this temperature, and they did not appear to be heat stressed.

Under natural conditions, sea lions favor the windward side of islands on which they establish their rookeries because they have much better tolerance to the sun when there is a strong wind present. During the day there is a regular procession of the animals toward the sea, as solar radiation increases during the morning, and a return inland in the late afternoon. Wet sea

Because sea lions dissipate more body heat on wet sand than on dry sand, this South American colony has chosen a damp resting area.

FRANCISCO ERIZE, BRUCE COLEMAN, INC.

lions begin to move inland first, followed by animals that have dried out near the edge of the water. There is generally more activity in sea lion rookeries at night, when the heat produced by physical activity is dissipated more readily.

The absence of effective evaporative cooling mechanisms in sea lions may indicate a physiological strategy designed to conserve water, rather than to maintain a constant body temperature. In their natural habitat, the only water available to sea lions is seawater and the water in their food. It is uncertain how much seawater they drink or if they drink any at all. Evaporative cooling means a loss of water, which must be replaced or dehydration will ensue. Perhaps considerations of water economy take precedence over the regulation of body temperature.

It seems logical that animals that are more at home in the sea should rely heavily on immersion in seawater to solve their thermal problems. Their poor heat tolerance ashore may be conducive to an even more aquatic existence for these animals, which evolved from terrestrial ancestors. □

The Ritual of Maize

Whether you pound it, grind it, or boil it, what we refer to as "corn" is an American staple

In one of the advanced North American cultures, it is customary for the women and children to leave their settled habitations in cities during the summer months and set up secondary domiciles in the countryside. This brings them (and their menfolk, who visit on weekends) into nostalgic contact with agriculture, which is actually practiced in the same area by the rapidly diminishing farmer clan. This temporary and highly stylized summer migration is also characterized by a series of rituals—such as systematic exposure to water and sun and symbolic voyages in small boats—epitomizing an escape backward away from culture and toward nature. But the escape is rarely complete, for the underlying tension between city and country, winter and summer, culture and nature, is felt at almost all times.

In this society, the farmer clan occupies a middle ground between culture and nature, operating within a natural context but doing so with culturally acquired methods. Appropriately enough, the farmers supply the raw material for summer's crowning rite: the sweet corn ceremony.

Sweet corn (*Zea mays* var. saccharata) is ideally suited to mediate the conflict between the townsman's craving for the absolutely primitive and the agri-*cultural* reality of his temporary setting. For sweet corn is on the order of an evolutionary throwback, an "immature" form of field corn that does not convert its sugar into starch. Strictly speaking, sweet corn is a mutation of field corn, specially cultivated for the first time in the early nineteenth century by white settlers. The Indians, apparently, didn't like it because its kernels are so pale.

On the one hand, then, sweet corn is a product of culture. Yet it is also preeminently natural because it must be eaten very soon after picking: the sugar vanishes in a few hours, some would say in a few minutes. Indeed, the corn ritual itself involves setting a pot to boil before the celebrant goes into the field to pick the sacramental ears. Then, quarry in hand, he runs back to the kitchen, shucks the corn, removes the tassels, boils the ears ever so briefly, and serves them with butter and salt. They are eaten with the hands in the traditional form of the ceremony, although some post-Columbians now use industrially manufactured cornholders.

Corn rituals of various kinds have been a fundamentally American cultural form since prehistoric times. No one knows exactly when corn was first domesticated from the wild grasses of Central America, but it is certain that the process occurred long ago and south of the border. Europe did not have corn before Columbus, and Europeans have never much taken to it. True, Italians of the Piedmont region dote on a cornmeal mush they call polenta. But, otherwise, what we, in the United States, automatically refer to as corn and eat with relish is, in the Old World, called maize and usually fed to animals.

The English language reflects this. "Corn" as in "alien corn" or the Corn Laws, means wheat to a Briton, oats to a Scot. Etymologically, "corn" means kernel and, historically, it has denoted the staple grain of a region.

In this hemisphere, maize was the indigenous corn. It has been partially, but not completely, supplanted by wheat in the United States. But any compendium of this country's "traditional" recipes always includes a wide array of maize preparations from fritters to spoonbread to hominy grits to corn chowder. The national spirit is corn whisky, called bourbon, after a county in Kentucky where it supposedly was first distilled.

Moving southward, the supremacy of corn is the overwhelming dietary fact of American life. The Mexican cuisine would be unrecognizable without tortillas and a thousand other cornmeal concoctions. For most other descendants of pre-Columbian America, corn is also *the* staple, the staff of life.

As a result, lurking behind the post-Columbian frenzy of the sweet corn ritual is a common tradition of corn worship and corn technology that links our tribe with the Senecas, the Hopis, the Aztecs, and the modern Colombian peasant women pounding corn in a mortar. For all of us, civilization, the settled life, began with corn.

As every schoolchild knows, Squanto, the friendly Indian, made it possible for the colony at Plymouth to survive when he showed the Pilgrim tenderfeet how to plant corn and fertilize it with fish. In another myth of international cooperation, the Zuñi trace their origins to a joint effort by two clans who first managed to grow corn. They celebrated this union of fertility with the dance of the corn maidens.

The eternal female principle may have led corn upward out of the ground, but this power rarely seems to have done women much practical good. Women did the work, nearly everywhere, of pounding corn into flour with heavy wood pestles in mortars made by burning away the insides of an upended log. Women mixed corn with a mild lye (a mixture of water and hardwood ash) to loosen the hulls and then strained out the edible hominy (Algonquin rockahominy) through wicker baskets. And it was a woman whom the Aztecs sacrificed in midsummer at the time of the corn harvest. Dressed in the splendid raiment and jewels of the goddess of the ripe corn, Xilonen, she presided over an all night ritual of dance and song. In the morning, accompanied by other women bedecked with yellow flowers, she went up the steps of the maize goddess's temple. One priest pulled her onto his back. Another priest, all in feathers, cut off her head, then ripped out her heart and threw it in a dish. This lovely ritual lifted the taboo on eating corn.

Today, the corn harvest is still a matter of life and death for women and men who depend for vital protein on the hybrid, specialized maize of the so-called green revolution. This scientific (cultural) improvement on natural maize was a blessing to the world's hungry, but genetic overspecialization left crops vulnerable to parasites. In 1970, more than half of the United States corn crop consisted of high-yielding, inbred strains of maize, and almost all seed production was based on T-type male-sterile cytoplasm. Long gone was the genetically varied crop of Indian days, multicolored, immune to decimation from one parasite because of its diversity. Nineteen seventy was also the year of the southern corn-leaf blight race T epidemic, which destroyed millions of bushels of vulnerable hybrid corn. Since then, plant breeders have been exploring the genetic pool of other maize varieties preserved in maize germ plasm banks. Their goal is to engineer high-yield corn strains that will also resist infection. Another route to the same end has recently been proposed by Walton C. Galinat, a botanist at the University of Massachusetts. He suggests that the "long-range solution may be the difficult extraction of polygenic resistance from the wild relatives that have adapted to survive under constant infestation." In other words, plant geneticists should widen their nets to include the hardy undomesticated cousins of maize such as teosinte, a grass that has evolved natural immunity. If this plan is followed, it will repeat or at least parallel the original, empirical domestication of corn by the original inhabitants of Central America. No doubt, this time around we can succeed without ritual sacrifice, but it is a good idea not to lose the ability to venerate the natural magic of maize.

JOHN RUNNING

Creole Summer Corn Soup

2½ pounds beef short ribs
2 diced and seeded tomatoes
4 ears of corn
Salt
Pepper
1 seeded jalapeño pepper (or 1 seeded dried red chili)
1 tablespoon butter, softened
1 tablespoon flour
Toasted bread rounds

1. Bring 2½ quarts (10 cups) of water to a boil in a large pot.
2. While you are waiting, scrape the kernels from the cob, chop roughly, and reserve. Also reserve the cobs.
3. Add the short ribs to the boiling water and bring to the boil again. Skim carefully. Add tomatoes and corncobs. If necessary, add more water to cover. Let boil once more. Reduce heat and simmer slowly for four hours. Then remove and discard cobs. Add enough water to maintain original level (before cobs were added).
4. Add the chopped corn kernels, salt and pepper to taste, and the jalapeño or chili. Simmer for another hour.
5. Work the butter and flour together with a wooden spoon in a small bowl to make beurre manié.
6. Whisk the beurre manié into the simmering soup 15 minutes before it is done cooking.
7. Skim off excess fat and serve soup in large bowls with toasted bread rounds on the side or as croutons in the soup.

Yield: 8 servings

Raymond Sokolov is a food columnist and editor of Great Recipes from The New York Times.

Lewis M. Cutter *Rhinoceros and zebra, Tsavo National Park, Kenya*

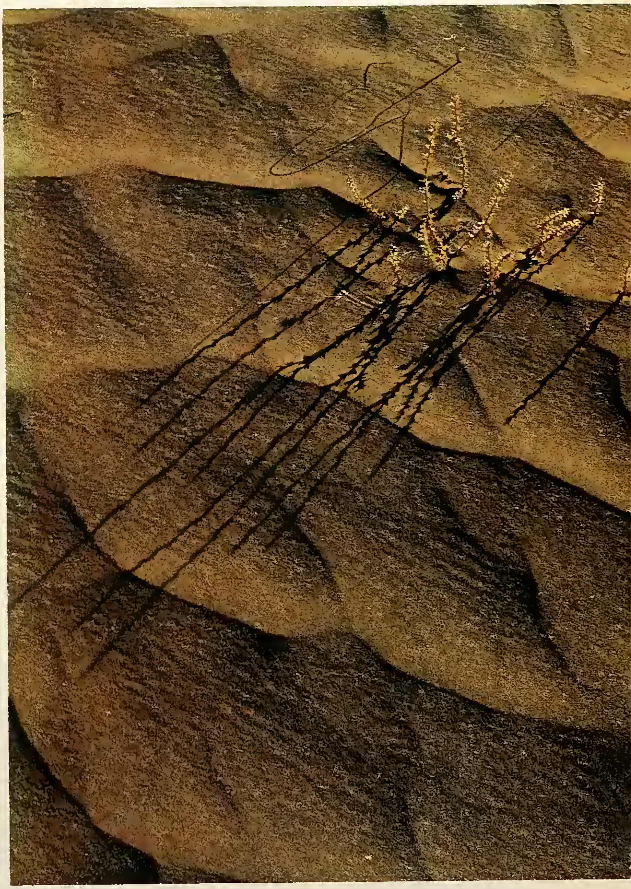
Josephine A. Cikel *Emergence of geometrid moth*

Roger A. Heath *Snake eating trout, Kern River, California*

Mark Potere
Long Point,
Rancho Palos Verdes,
California

M. J. Guariglia
Hippopotamuses wallowing, Uganda

Bill Ratcliffe
Tumbleweed in sand dunes, Utah



J. Nicola Viani
Terraced rice fields, Nepal

Lou Howort
Beach, San Blas, Mexico

Runner-up

Dennis Wickes
Avocado plant

(*Continued from page 41*)

volume of photographs submitted, we were also impressed by the quality—the expert use of sophisticated cameras and lenses. This made the preliminary judging difficult. But the most difficult task was the selection of fourteen prizewinners from the hundreds of transparencies that passed the first screening.

The judges brought a variety of experiences and perspectives to the job. Arthur Rothstein has been a photographer for forty years; as a member of the Farm Security Administration from 1935 to 1940, he took thousands of pictures of rural and small-town America. Then he joined *Look* magazine, where he worked in the photographic department until the magazine ceased publication in 1971. Peter C. Bunnell, now professor of the history of photography and modern art and director of the Art Museum at Princeton University, was formerly curator of photography at The Museum of Modern Art in New York City. Thomas Page, designer of *Natural History*, has been with the magazine for thirteen years.

Above all, the judges were looking for pictorial imagination. Impressed by the technical competence of most of the photographers, they wanted to find something more profound—evidence of personal involvement with the subject. Most of the pictures, they felt, were good records; the photographs they selected as winners revealed an interpretive input, an attempt to deal with a pictorial idea. The pictures show not just the beauty of the natural world, but the photographer's struggle to capture the art. Charles Steinhacker described this problem clearly when, talking about the circumstances under which he took the Grand Prize-winning photograph, he said: "Some situations are inherently photographic, some are not. The scene of the elk against the hillside definitely was, and I immediately saw the visual analogy to a Japanese print."

The prizewinning photographs will be exhibited at The American Museum beginning in September. □

Driftwood Fantasy

"Folk art is a good place to return for traces of the original impulses that infuse painting and sculpture"

by Robert Sommer

The origins of art can be traced either in the history of the human species or in the life of the individual. The archeologist searches for art both in caves once occupied by prehistoric man and among the ruins of ancient civilizations. The developmental psychologist studies art by comparing drawings made by children of different ages. In contemporary society, observation of the expression of art is not restricted to any one profession; it has become the general concern of art critics, philosophers, historians, and psychologists.

The question of how art develops became important to me while I was doing field work for a book on American folk art. After seeing three or four homemade sculptures in front yards, I began to consider the critical questions of definition and classification. Did these contemporary totems represent decoration, art, or some part of both? As I began collecting examples, some answers began to appear.

No single definition of art will satisfy everyone, but there are identifiable categories of creative work that move in a logical progression toward accepted notions of pure art. These stages can shed important light upon the nature and expression of the creative impulse.

One of my searches for folk art took me to the coastal communities of northern California and Oregon. My particular interest during this trip was the use of driftwood as an art medium. Driftwood has many advantages as an art medium—it exists in great abundance, it costs nothing to secure other than labor, it possesses a multitude of suggestive shapes and textures, and it is extremely durable. Apart from its noncommercial use as firewood, driftwood has virtually no practical value.

I have spent several years observing and photographing the ways in which local residents use the abundant driftwood that accumulates on nearby beaches. Most people, content to view it as part of the coastal landscape, do not see any extrinsic qualities in driftwood; a few supplement their incomes by collecting it in quantity and selling it to tourists and landscape supply stores; and some use it to decorate their front yards and porches.

In fewer than 1 percent of the arrangements I saw in front yards was there a conscious attempt to submerge the identity of the individual pieces of driftwood and achieve a completely different figure. Of this minority a few have gone the next step toward the creation of art, consciously altering the individual pieces to enhance the new figure. Regardless of whether the embellishment of driftwood is necessary or desirable, the deliberate change of the pieces or the insertion of a new element, such as a red ball for a nose, marks a further movement in the direction of art.

There are some professional artists who specifically seek out and use driftwood as a medium. Artists in several studios along the north coast make driftwood sculpture and sell it to tourists. There are also several public shoreline areas where sculpture made by anonymous artists is displayed to passing motorists. In northern California and Oregon, I have found two large, public driftwood galleries and many minor ones.

The principal ingredients for a public display area, or gallery, are materials, accessibility, and an audience. All these conditions are met in Emeryville, a tacky industrial city along the east shore of San Francisco Bay, and near Arcata in the lumber country of northern

Sculpture on Route 1, north of Fort Bragg, California

ROBERT SOMMER

California. Great quantities of driftwood are available in these areas, and each adjoins a busy highway so that the work is well displayed.

Emeryville sculpture also makes use of nondegradable debris that washes in from the entire Bay region. Plastic bottles, aluminum cans, and discarded toys add color and variety to the driftwood creations. The work at Emeryville is ecological art in the true sense; only the anonymous artists of the mudflats seem capable of recycling pieces of Styrofoam and Clorox bottles. At Arcata, where the population density is light and plastic debris is minimal, sculpture is made almost entirely of wood.

Between the piles of driftwood lying undisturbed on the beach and the professional driftwood productions sold in galleries lie recognizable stages in the evolution of art. I will recapitulate these and add several others to show how art evolves.

The first stage is ordinary perception: Viewing the driftwood on the beach as part of the natural landscape without endowing it with any special significance apart from its setting.

The second stage is functional perception: Seeing the driftwood as potential firewood or as material for building a beach shelter. This stage is inimical to the development of an esthetic view of the driftwood.

Stage three is decoration: No symbolic significance is attached to the shapes, colors, or textures. The wood is merely displayed in front of a house, in the same way that a flower or a bush is considered attractive without representing something else.

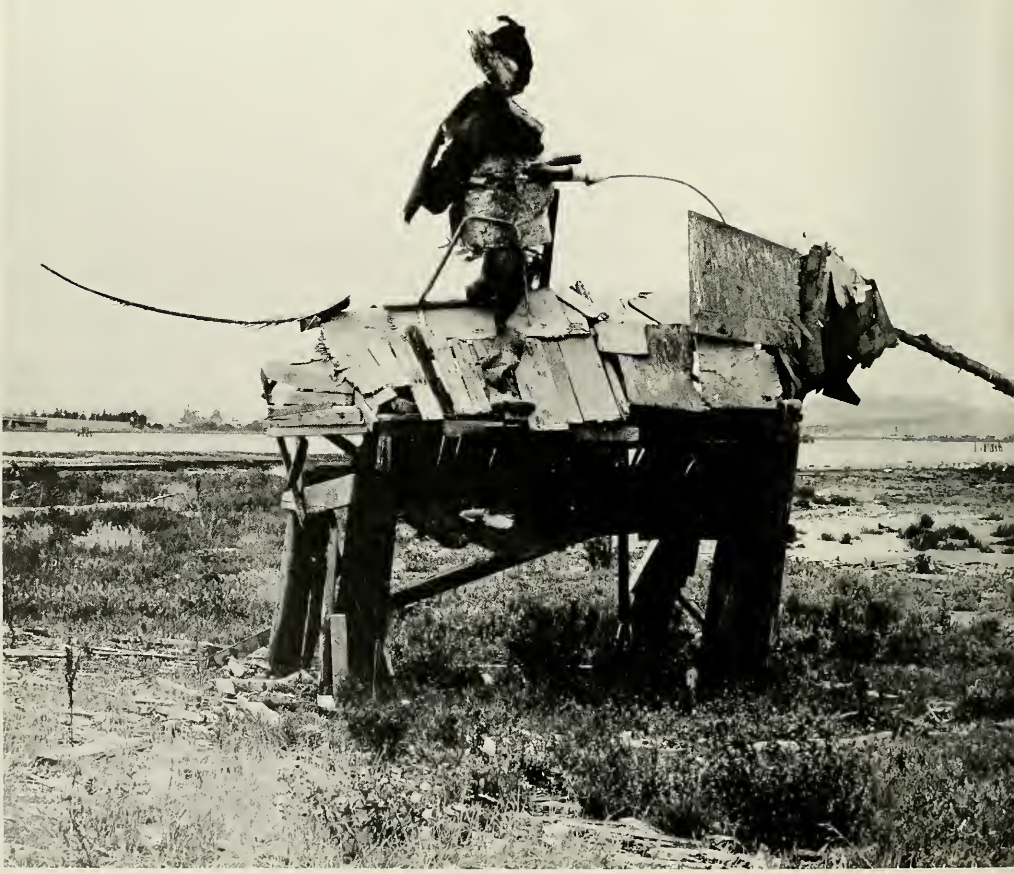
The fourth stage is fantasy. Through the powers of imagination, people view driftwood pieces as animals, humanoid figures, or other items, but make no attempt to facilitate or enhance this new image through manipulating, shaping, or arranging the pieces. When I asked local residents if there was driftwood sculpture in the area, the usual reply was that they thought of driftwood as sculpture in itself, rather than as material for sculpture.

Stage five is perceptual discovery and arrangement: A person may find a piece of wood that resembles a bird or a water buffalo and use it to decorate his front yard. The piece will be displayed in such a way as to accentuate the form perceived by its discoverer. The more obvious features of the head, eyes, or antlers are made evident to the viewer.

Stage six is embellishment: A piece of driftwood that suggests a

Emeryville mudflats across San Francisco Bay

ROBERT SOMMER



particular idea is improved to enhance this perception. A redwood burl that looks like the head of a deer may be combined with a branch that resembles antlers. An undulating log that resembles a seal may be enhanced by the creation of eyes, nose, or flippers. Several pieces of driftwood may be combined, a piece may be burned or burnished or painted to highlight certain features, or man-made objects, such as marbles for eyes, may be added.

The final stage is deliberate representation: An entirely new form may be created out of disparate and unrelated pieces. A person will go to the beach with the preconceived idea of creating an elephant or an abstract piece. He will collect driftwood and combine the pieces according to his internal image. In this stage, the artist's image is primary; the individual driftwood pieces are important only in the context of the over-all conception.

These same stages in the evolution of art occur in other places with other media. In mountain and desert regions, rocks are used as decorative items. If one looks closely, the progression from ordinary perception to professional sculpture can be observed. Some oddly shaped rock formations become local tourist attractions and are depicted on postcards. One can look at almost any jagged mountainside and see forms that suggest images.

Sadly, few adults are willing to let their fantasies run free over the hillside in this way. Most rocks that are deliberately used for decoration have odd shapes, unusual colors, and variegated textures, such as lava rock or serpentine jade. Like driftwood, these pieces are chosen for their interest and ambiguity. Occasionally one finds rocks that have been painted, arranged, or combined with other items to create new forms.

Where sandstone abounds, stone carving has a long history going back to petroglyphs. In American cities one can also find rudimentary drawings in concrete sidewalks. In desert areas one will occasionally find homeowners who have created designs using different-colored stones. This is about the most advanced stage of front yard stone art. Stone is just too hard and brittle a medium for nonprofessionals to

Two expert ways to bird watch better:

Swift's Audubon and Triton.

If bird watching is more than a hobby for you, look into these superb binoculars. Both were designed and perfected in cooperation with a team of world famous ornithologists.

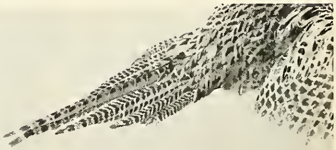
The Audubon MKII has an extremely wide field of 445 feet, the extra power of 8.5X, a relative light efficiency of 44.2 and exit pupil of 5.18mm. This provides clear, sharp vision even in deep shadow. For more general nature study, try the Triton MK1 7X35 Prism Binocular.

There's nothing swift about the way we make our products. All our instruments are expertly crafted and painstakingly inspected. We take no short cuts, we don't believe in novelties, and if one of our products has to be serviced, we have representatives the world over.

For the name of your dealer and a copy of our new brochure, write:

SWIFT®

Swift Instruments, Inc., 952 Dorchester Ave., Boston, Mass. 02125



Because they're birds and they're free! So you have to change your photo habits. One ingenious solution is a zoom lens. It gives you a fast change of focal lengths without moving the camera from your eye.

The Vivitar Automatic Zoom lens goes from 85 to 205mm, opens up to an impressive f3.8 and isn't any larger than most standard 200mm lenses. The highly sophisticated optical design has 13 elements in 9 groups. The Vivitar Automatic Zoom is designed to fit most 35mm SLR cameras.

See a demo at your photo dealer or write for test reports by leading photo magazines.

Vivitar Zoom Lenses

Marketed in the U.S.A. by
Ponder&Best, Inc.,
1630 Stewart Street,
Santa Monica, California 90406.
In Canada: Precision
Cameras of Canada, Ltd., Que.

Why don't birds stay where they are while you change lenses?

actual
size

oneness

A subtle linking of man's religious symbols, delicately wedded together by the artisan.

With illustrated descriptive booklet

14K with 24" chain $37.50
Sterling Silver $16.75

ISAAC SOLTES DESIGN NH
1923 S. McPherrin Ave.
Monterey Park, Calif. 91754
Check or Money Order / Money-back Guarantee

BROOKS 8×56

NOCTURNAL EYE BINOCULARS

ALLOWS YOU TO SEE OBJECTS USUALLY INVISIBLE IN DIM LIGHT. ROOF PRISM. RUBBER CLAD. 13% BRIGHTER PLUS 15% MORE MAGNIFICATION THAN 7X50. TWILITE FACTOR AMAZING 21. BRIGHTNESS FACTOR ASTOUNDING 49. FOR MARINERS, BIRDERS, POLICE, SPORTS. LESS THAN $100.00.

BURLEIGH BROOKS OPTICS, INC. • 44 BURLEWS CT., HACKENSACK, N.J. • 201-489-1300

Cut film costs in half!

Load Your Own Color and Black & White

Watson 100 Film Loader

Write for details to:
Burke & James inc.
44 Burlews Ct., Hackensack, N. J. 07601

JEWELRY
LIFE SIZE
BC-6 Byzantine Cross
EY-1 Sacred Eye Ring
(Ancient Egyptian Doctor's Amulet)
AP-5
ANKH
PENDANT
2½" long

Ancient Jewelry Replicas
In 14 Karat Gold & Sterling Silver

		Sterling Silver	14K. Gold
AP-5	Ankh Pendant 24" ch.	$32.50	$119.50
BC-6	Byzantine Cr. 24" ch.	35.00	125.00
EY-1	Sacred Eye Ring	29.50	119.50

Rings sized to 11½ no extra cost. • Money back guarantee. Add $1.50 for insured postage. • Orders shipped promptly. • Bankamericard & M.C. for orders $50.00 minimum.

COLLECTOR'S CATALOG . . . picturing relics from ancient worlds—BC to AD. Plus special Jewelry Catalog showing ancient replicas in precious metals. Both catalogs—50¢ . . . Free With Order!

VISIT GALLERY—APPT. ONLY—CALL CI 6 0793

aladdin house, ltd.
Dept. NJ874 • 648 Ninth Ave. • N.Y. 10036

shape as a decorative item. There are no stone galleries created by anonymous nonprofessionals comparable to the driftwood display areas mentioned earlier.

Rock arrangements are also used to display messages. A prominent hillside overlooking a small town or a university campus often displays a logo formed of whitewashed rocks. In Mexico, whitewashed stones are used for political slogans. This medium is inexpensive, flexible, and relatively durable. High school and college students frequently alter the appearance of an earth levee of the Sacramento River by using an accumulation of whitewashed stones for fraternity insignia, political slogans, and identity displays. This is not a visual art, and the awkwardness of the medium makes it impractical as a literary form. Rock sloganeering reflects a functional rather than an esthetic view of the landscape.

What impels a person to move from one stage in the evolution of art to the next—from using driftwood pieces as a decorative item to combining them into an entirely new whole? Artisans who embellish driftwood are not terribly articulate about their motives. A piece of driftwood "just looked like a seal," and a seal needs flippers. This eminently sensible explanation places us in the position of trying to find out why the other 99 percent of householders either did not perceive the animalism in their own driftwood or, if they did, made no effort to accentuate its form.

The emergence of art is not simply a matter of taste or style, although this will affect the final product. Rather it is an esthetic orientation to the environment. The nature of artistic creation involves the ability to perceive a lump of clay as the potential representation of something else, as well as the talent and motivation to effect the transformation. With the exception of the anonymous artisans of the Emeryville and Arcata galleries, the driftwood art I observed in my expedition along the north coast did not require exceptional talent or ingenuity. Most of the items created were well within the realm of talent possessed by the average ten-year-old. It does not take great skill to make a bird or humanoid out of assorted driftwood and other objects if given the instruction to do so. The critical element I observed was

As in 1973, we offer three groups of eight intrepid travelers the world's most challenging tourist experience:

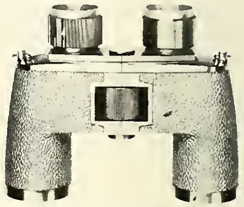
Greenland Dog-sledging Expeditions

MARCH 14, MARCH 28 and APRIL 11, 1975

Two weeks are spent on Greenland's breathtaking East Coast under the expert guidance of Major Mike Banks, leading Arctic explorer. Travel is by helicopter and Husky-drawn sledges

Detailed brochure, and a report of the 1973 expedition reprinted from International Wildlife Magazine, available from

HANNS EBENSTEN TRAVEL, INC.
55 WEST 42 STREET, NEW YORK, NY 10036
TELEPHONE (212) 354 6634



BUSHNELL 7x35 CUSTOM

Mfg. List $139.50 Postpaid $84.50

This is an example of the deep discount prices on high quality optics that is found in our FREE catalog. This catalog lists and illustrates an outstanding selection of camera lens, telephoto lens, telescopes, binoculars etc., plus valuable information on how to properly select them. Write for it today.

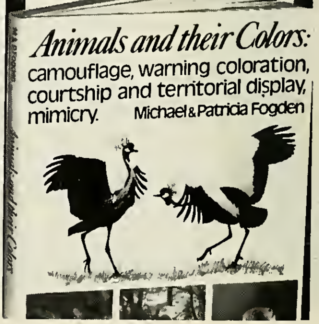
GIL HEBARD OPTICS
COURTHOUSE SQ., KNOXVILLE, ILL. 61448

How and why animals use their colors

This intriguing book explores the ways in which animals use their natural colorings to disguise themselves, startle predators, lure prey, attract mates, etc. There's detailed information on how color in animals is formed and much more. Over 180 beautiful color illustrations. Size 8½" x 11".

$9.95, now at your bookstore, or send check or money order to CROWN PUBLISHERS, 419 Park Ave. South, New York, N.Y. 10016

Crown


Animals and their Colors:
camouflage, warning coloration, courtship and territorial display, mimicry.
Michael & Patricia Fogden

I want to give Natural History as a Gift

Enter my gift (a one-year Associate Membership in The American Museum of Natural History and 10 issues of Natural History magazine) for the people listed below. **Bill me later at $8 for each gift.**

SEND GIFT TO: ☐ NEW ☐ RENEWAL

NAME

ADDRESS

CITY STATE ZIP

SIGN GIFT CARD FROM:

SEND GIFT TO: ☐ NEW ☐ RENEWAL

NAME

ADDRESS

CITY STATE ZIP

SIGN GIFT CARD FROM:

MY NAME

ADDRESS

CITY STATE ZIP

And That's Not All

With their membership and subscription, my friends will also receive two bonus books (special members' editions); free admission to the Museum; use of the Members' Reception Lounge and a discount in the Museum Shop.

NATURAL HISTORY

Outside U.S.A., please add $2.00 per year for postage.

J 124

FIRST CLASS
PERMIT NO. 4946
DES MOINES, IOWA

BUSINESS REPLY MAIL
No Postage Stamp Necessary if Mailed in the United States

POSTAGE WILL BE PAID BY—
NATURAL HISTORY
P. O. Box 5000
Des Moines, Iowa 50306

the rarity of the *idea* and of the willingness to bring the image to tangible realization.

I accept the premise that any ten-year-old has the ability to draw a reasonable picture of almost anything around him. Schools, however, make little effort to develop skills in drawing or sculpture since these subjects are regarded as frills in contrast to abstract thinking, which is considered real and practical. Few parents are unduly upset if their child receives a poor grade in drawing or pottery. The impulse to create external representations of internal images, while strong in early childhood, receives little support after the age of seven.

Having seen some examples of adults who transformed driftwood into sculpture, I am compelled to ask how these few people managed to avoid the atrophy of their esthetic impulses. It is also noteworthy that these individuals felt sufficiently free to display their works in their front yards. Freedom from community pressure is undoubtedly one reason why more of the decorated yards were found in rural areas than in small towns or cities.

Perceiving the world in esthetic terms does not insure that one will bring one's images to realization, but it is a necessary first step. Without seeing the symbolic significance of a lump of clay or a palette of colors, there can be no incentive to create art; driftwood remains driftwood, a lump of clay remains a lump of clay. Sensing the possible transformations and possessing sufficient motivation to effect them make art possible. None of this guarantees great art or even good art. But without esthetic perception and the impulse toward creative work, there would be no art at all.

The costs of the neglect of art are evident in the dreariness of our cities, as well as in the isolation of artists. Art has traditionally tended to put people in touch with mystery and truth. But in the last decades artists have defined their role as reflecting both individual and social chaos and isolation. Observing the current professional art scene, which uses sheets of plastic draped across canyons, self-destructing toys, and lines traced across the desert, I have to conclude that artists have gotten off the track somewhere. Folk art is a good place to return for traces of the original im-

Available at fine photo dealers or write for literature to: BERKEY MARKETING COMPANIES, INC.
P.O. Box 1060, Woodside, N.Y. 11377
In Canada: Berkey Photo (Canada) Ltd., Ontario

the finest aluminum cases in the world!

ZERO HALLIBURTON
ALUMINUM CAMERA CASES
BY THE PEOPLE WHO CREATED THE POST-RECOVERY APOLLO MOON ROCK CONTAINERS

TRAVEL THE WORLD OF LINDBLAD

We are pleased to announce the

M.S. LINDBLAD EXPLORER'S*

exciting 1975 Cruising Program taking us through the waters of seldom-seen parts of our oceans.

Darwin and the Beagle February 17—March 19
The Amazonas to Dakar March 11—28
From the Senegal to the Nile March 27—April 25
Black Sea—Cruise A April 18—May 21
Black Sea—Cruise B May 16—June 18
Baltic June 16—July 19
The Arctic Adventure 1975 July 15—August 19
British Isles and Faroe Islands August 28—September 25
Amazon Upstream September 24—October 24
Amazon Downstream October 31—November 28

Please write for our cruising expeditions program for 1975.

LINDBLAD TRAVEL, INC.
Dept. NHEX874
133 East 55th Street, New York, N.Y. 10022 (212) 751-2300

*Panamanian registry

Imagine the pleasure of owning your own handsome set of

ANTIQUE ORIENTAL IVORY CARVINGS (NETSUKES)

You can start your own collection of these authentic replicas today.

These beautiful works of art are faithful reproductions, exact in every detail. There are 24 beautiful pieces in all, offered to you in sets of 4 at only $3.95. For a limited time only you can take advantage of our special offer and order a 12 piece set for only $9.95. Order today and receive FREE our specially prepared booklet "The History and Legends of Art Miniatures (The Netsuke)".

MAIL ORDERS TO:
IMG PRODUCTS, INC.,
27 E. 39th STREET,
NEW YORK, N.Y. 10016. N.H.-3.

The history and legends of
Art Miniatures

Please rush me ______ set(s) of the special limited offer of the 12 piece Art Miniature set @ $9.95 per set and/or ________ 4 piece sets at $3.95 per set. Total enclosed $__________

name ____________________

address ____________________

city ____________ state ______ zip ______

MAIL ORDERS TO:
IMG Products, Inc., 27 E. 39th Street, New York, N. Y. 10016 N. H.-3

Emeryville mudflats

pulses that infuse painting and sculpture.

The study of almost any material or medium, including wood, stone, sand, or even snow, can reveal a transition between functional and esthetic perception. The universality of the creative impulse guarantees the expression of art among all groups of people using whatever materials are available.

The search I have made for representational art along the northern California coast can be made in the snowy front yards of New England. Children are much more aware than adults of snow's properties as a

ROBERT SOMMER

plastic medium for both snowballs and sculpture.

In the child's snowman lie the origins of the graceful ice sculptures that are a part of winter festivals in many cities in Canada and the northern United States. The persistence of the snowman as a folk art form, as well as its ultimate linkages to professional ice sculpture, provides some optimism for the survival of the artistic impulse. Knowing what induces adults to continue and develop the creative activities of childhood will provide some clues to widening the role of the arts in contemporary society. ☐

Nikon wants you to see better

Nikon prism binoculars start with world-famous Nikon optics, made from Nikon optical glass. Lenses and prisms for right and left barrels are precisely matched and collimated, and the optical parallelism of both barrels is verified.

That's why with Nikon binoculars you enjoy brilliant, sharp, full-field viewing without strain or fatigue, even for long stretches. Now, find out how little more it costs to see better, longer. At Nikon camera dealers and selected optical departments. Write for literature Folio 18, Nikon Inc., Garden City, N.Y. 11530. Subsidiary/Ehrenreich Photo-Optical Industries, Inc. EPOI (In Canada: Anglophoto Ltd., P.Q.)

Nikon Binoculars

TRAVEL THE WORLD OF LINDBLAD

A totally fascinating new world dawns when you travel with

LINDBLAD IN AFRICA

Because we believe we spend more time and effort researching our African safaris than anyone else, we can offer the most rewarding journeys to this fabulous continent. Africa is a nature paradise and probably the most photogenic part of the world. It is teeming with an unbelievable variety of wildlife. And Lars-Eric Lindblad offers a wide selection of African tours. We operate our famed Wing Safari (why spend your vacation on dusty roads), The Lindblad Safari, The Botswana Wing Safari. You may want to visit historic Ethiopia and Yemen, the lovely Seychelles in the Indian Ocean, take our West Africa Safari or embark on our newly scheduled Round Africa Expedition. We travel only in small groups and our safaris, unlike most others, are all-inclusive. Write today for our comprehensive "Lindblad in Africa" brochure.

LINDBLAD TRAVEL, INC.
Dept. NHAF874
122 East 55th Street, New York, N.Y. 10022
(212) 751-2300

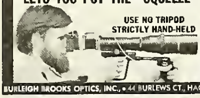
enjoy the treasures
of mother earth!

the collector's cabinet
1000 Madison Ave., New York, N.Y. 10021
"the treasure house of natural history!"

Branches: Dania, Fla., Miami Beach, Fla., Syracuse, N.Y., Chadds Ford, Penna., Springfield Mall, Virginia. (Franchise information available)

Also at Bloomingdale's, N.Y. and 144 other fine dept. stores nationwide. Write for the store nearest you. Catalog "H" and 7 jumbo color postcards $1.00.

FITS ALL 35 mm SLR'S (INTERCHANGEABLE LENS HEADS 200, 400, 640 mm) ALSO FITS 8 mm, 2¼ x 2¼ & 16 mm.
NOVOFLEX WILDLIFE KIT **BROOKS** NOVOFLEX WILDLIFE KIT
LETS YOU PUT THE "SQUEEZE" ON YOUR BIRD
USE NO TRIPOD
STRICTLY HAND-HELD
DON'T FUMBLE WHILE YOUR BIRD IS FLYING AWAY. WITH NOVOFLEX YOU FOCUS WITH ONE HAND BY SQUEEZING PISTOL GRIP. FOLLOW YOUR BIRD (IN FOCUS) NO MATTER WHERE HE FLIES. FOR COMPLETE DETAILS WRITE.
BURLEIGH BROOKS OPTICS, INC., • 44 BURLEWS CT., HACKENSACK, N.J. • 201-489-1300



AZTEC—MAYA LAND CRUISE
An unprecedented program in Mexico. Great archaeological sites, untouristed villages, stunning scenery. 31 days of magnificent diversity. Frequent departures. Brochure - your travel agent or
WORLD TRAVEL ASSOCIATES, INC.
219 Palermo Ave. Coral Gables, Fla. 33134

BOOK HUNTING?
Virtually any book located—no matter how old or long out-of-print. Fiction, nonfiction. All authors, subjects. Name the book—we'll find it! (Title alone is sufficient.) Inquire, please. Write: Dept. 65.
BOOKS-ON-FILE
UNION CITY, NEW JERSEY 07087

STRANGE PHENOMENA
A SOURCEBOOK OF UNUSUAL NATURAL PHENOMENA
Compiled by WILLIAM R. CORLISS
Over 350 accounts of ball lightning, the Andes glow, earthquake lights, Indian Ocean wheels of light, the Barisal guns, and other strange geophysical phenomena gleaned from *Science, Nature, Scientific American,* and other publications. Thorough index.
277 pages, hard covers, $6.95 postpaid
Published by
WILLIAM R. CORLISS
BOX 107A, GLEN ARM, MARYLAND 21057

SURVIVAL IN THE
WILDERNESS

Adirondack and Western U.S. High Peaks, Canadian & Northeastern Waterways.
Fall, Winter, Spring: Weekend Trips, Holiday Outings, Concentrated Courses.
Summer: Two-week & Intensive Month-long Courses & Expeditions. Basic and Advanced Survival Instruction. On foot, skis, snowshoes, by canoe. Write for definitive brochure: H
North American Wilderness Survival School
205 Lorraine Ave. Upper Montclair, N.J. 07043
Tel: 201-783-7711

How Old Is the Universe?

Each revision of galactic measurements has added enormously to the world's estimated age

How old is the universe? In 1972 Allan Sandage, an astronomer at the Hale Observatories, announced new observations on the expansion of the universe that added several billion years to the previously accepted value. Sandage's results suggest that the age of the universe is probably about 13 billion years and could be as great as 18 billion years. For comparison, the age of the oldest stars in our galaxy is about 11 billion years. According to measurements of the ages of the moon rocks, the solar system is only 4.6 billion years old—a relative newcomer on the celestial scene.

The Sandage result is the latest in a series of steady increases in the estimated age of the cosmos that go back several centuries. One of the most precise calculations was put forward in 1648 by Bishop Ussher of Armagh, Ireland, who counted the begats in the Book of Genesis and concluded that the world began at 9:00 A.M. on Sunday, October 23, in the year 4004 B.C. An estimate of roughly 6,000 years for the age of the universe was accepted by nearly everyone in the Western world until the nineteenth century, when geologists uncovered disturbing evidence that the earth must be far older. The geologists observed that streams and rivers steadily wear away their banks and transport the particles of soil to the oceans. This effect cuts down the average height of the land, wearing away a layer of continent one mile thick every 50 million years. Since some places on the surface of the earth showed signs that a one-mile-thick layer of material had been worn away and replaced many times, it followed that the earth must be at least several hundred million years old. Some geologists thought the earth might be infinitely old. Their views on the antiquity of the earth were the antithesis of the biblical concept of an act of creation. James Hutton, the father of modern geology, wrote: "We find no vestige of a beginning."

Charles Darwin came to a similar conclusion when he studied the evidence for evolution in the fossil record. He felt intuitively that the complete history of life on the earth could only be explained by a record going back billions of years. He wrote: "We see nothing of these slow changes in progress, until the hand of time has marked the lapse of ages. . . ." But Darwin was reassured by the geologists' new ideas on the age of the earth; he knew that enough time was available, and that was the secret strength of his theory. "We have almost unlimited time," he wrote in 1858, one year before the publication of *Origin of Species.*

Darwin's intuitive feelings regarding the age of the earth clashed with the mathematics of Lord Kelvin, the British theoretical physicist. At about the same time that Darwin published his great work on evolution, Kelvin announced that the earth could not be more than twenty to forty million years old. He arrived at this result by computing the time required for the earth to cool down from an originally molten state to its present condition. He arrived at another estimate of the age of the universe by calculating the maximum time that the sun could have lasted while pouring out energy at its current prodigious rate. His calculation assumed that the sun derives its energy from the heat of compression generated as it collapses under the constant enormous pressure of its own weight. By these methods, Kelvin finally arrived at an estimate of twenty-two million years for the age of the earth.

Darwin was very upset by these developments because twenty-two million years was not enough time to account for the millions of species of animals on the earth in accordance with his theory of evolution. If Kelvin's mathematics was right, Darwin's intuition was wrong. Darwin thus seems to have taken a personal dislike to Kelvin, referring to him in a letter as "the odious specter."

In the conflict with Darwin, Kelvin displayed the confidence of a man who knows his numbers are right. But intuition triumphed over mathematics, as has happened more than once in science. We know today that Kelvin's calculation on the age of the sun was wrong, because nuclear reactions are the source of the sun's energy, and the amount of nuclear fuel in the sun is sufficient to last altogether about ten or eleven billion years. We also know that his calculation of the age of the earth was invalid because heat is released within the earth's interior by the radioactive elements uranium, thorium, and potassium. This heat was not taken into account by Kelvin since he did not know it existed. The radioactive heat makes the correct value for the cooling time of the earth much longer than Kelvin's estimates.

These were twentieth-century discoveries, however. The weaknesses in Kelvin's calculations did not become apparent until Lord Rutherford, the British physicist and Nobel laureate, discovered the radioactive heating of rocks in 1904 and then discovered the existence of the atomic nucleus in 1911. Kelvin was still alive in 1904, but Darwin was dead. He had died in 1882, confused and troubled to the end by Kelvin's sharp attacks.

The earliest true measurement of the age of the earth was also conceived by Rutherford. The idea came to him through work done by Marie and Pierre Curie, who had shown that when an atom of uranium undergoes a radioactive change, it is converted eventually into an atom of lead. If a rock contains uranium, this means that with the passage of time, the amount of uranium in the rock is steadily depleted, while the amount of lead steadily increases. Rutherford reasoned that a measurement of the ratio of lead to uranium in a rock will reveal how long the decay has been going on, hence, how old the rock is. The first measurements of this kind showed that some rocks on the earth are at least one billion years old, and, therefore, the earth as a whole must be at least that old. This was the first scientific proof of the long duration of the earth's history.

Up to that point, astronomers had contributed little to human understanding of the history of the cosmos. The picture changed with the discovery of the expanding universe by the American astronomers V. M. Slipher, Milton Humason, and Edwin P. Hubble in the 1920s. They found that the light from distant galaxies displayed a reddening

FREE catalog
over 1500 unique tools, handy kits, precision instruments, technical supplies.

Our 22nd year of service to the World's finest craftsmen and technicians.

National Camera
2000 West Union Ave. Dept EDA
Englewood, Colorado, 80110

Send a FREE copy of the NC Flasher
name
address
city
state zip

National Camera
2000 West Union Ave. Dept. EDA
Englewood, Colorado, 80110

Share the Thrills of Exploring Outer Space!

$219.95 f.o.b. Hartford, Conn.
$15 Crating Charge

All DYNASCOPES, including this superb RV-6, 6-inch available on easy terms!

Now it's easy to join the thousands of serious amateurs who have discovered the excitement of exploring our mysterious universe. Your enjoyment begins right from the start, yet the challenges and rewards go on for years! And it's a hobby that can be shared at modest cost.

Choose From Many DYNASCOPES®

Picking a telescope to fit your needs and your pocketbook is simple when you select a DYNASCOPE — the same instruments used by more than 150 schools, colleges and observatories — and your satisfaction is guaranteed by a full-refund warranty.

FASCINATING GUIDE YOURS FREE!

Read these valuable facts before buying any telescope. Mail coupon or postcard for your complimentary copy of this helpful guide.

Criterion Manufacturing Co.
620 Oakwood Ave., W. Hartford, Conn. 06110

® TM Registered U.S. Pat. Office

CRITERION MANUFACTURING CO., Dept. NH-50
620 Oakwood Ave., W. Hartford, Conn. 06110
Please send your free Telescope Guide.
Name
Address
City State

effect of the kind produced when the source of the light is receding from the earth. The shift in color toward the red end of the spectrum was very pronounced for some galaxies, indicating an extremely rapid motion away from the earth. Apparently, all galaxies in the universe are moving away from us, and from one another, at high speeds—in some cases, in excess of one hundred thousand miles per second.

This discovery immediately suggested a method of determining the age not merely of the earth but of the entire universe. The reasoning behind the method is not complex. Consider again the picture of the expanding universe, in which, as time goes on, the galaxies move farther and farther apart. Now, in your imagination, reverse their motions and go *backward* in time. The galaxies must then come closer and closer together, until, at some point in the past, we arrive at a moment when they are all together in one place. At that moment, with all the matter and energy of the universe packed tightly together, the density and pressure in the universe must have been enormous, and the temperature must have been many trillions of degrees. The intense brilliance of the radiation that filled the universe must have been beyond description. The picture suggests the explosion of a cosmic hydrogen bomb. The instant in which the cosmic bomb exploded must have marked the birth of the universe.

When did it happen? We can calculate the moment accurately if we know the speeds at which the galaxies are moving apart today. If they are receding from one another very rapidly at the present, they must have been close together a very short time ago. That is, the birth of the universe must have occurred very recently. We must also know the distances that separate the galaxies at the present time; the farther apart they are at the moment, and the more expanded the universe is, the more time must have elapsed to bring the universe to its expanded state. If both the speeds and the distances can be measured, the age of the universe can be computed.

One could possibly invalidate this reasoning. The ingenious steady-state theory, put forward by the great trio of English cosmologist Herman Bondi, Thomas Gold, and Fred Hoyle, asserts that fresh hydrogen might be created continuously out of nothing, throughout the universe, at a rate that exactly fills the spaces left by the receding galaxies. New galaxies condense out of this fresh material, and the average distance between galaxies always remains the same. If this theory were correct, the universe would never change and its age would be infinite. Several lines of evidence, however, weigh strongly against the steady-state cosmology, and most astronomers have discarded it.

Returning to the cosmic-bomb picture of the universe, calculations by Hubble, based on the preceding ideas, led him to the conclusion that the universe was born somewhat less than two billion years ago. Hubble's result, which was announced in 1932, agreed nicely with the ages of the oldest rocks found on the earth up to that time. These ages were also in the neighborhood of two billion years. Everything seemed to be in order at last: the age of the earth and the age of the universe, measured by completely different methods, were approximately the same; and both ages were great enough to give ample latitude to the geologists and the biologists for their explanations of the changes in the surface of the earth and the changes in the forms of the creatures that inhabit our planet.

A few years later, an extremely embarrassing development occurred. The ages of certain meteorites were measured and were found to be four and a half billion years. Meteorites are extraterrestrial rocks that have not been worked over by erosion and other forces that change rocks on the earth. They should represent the original state of the solar system better than terrestrial rocks. Therefore, it was not surprising that meteorites could be slightly older than earth rocks. But it was a shock to learn that they could be billions of years older. If some meteorites are four and a half billion years old, the solar system must also be at least that old. Yet the solar system cannot be older than the universe.

The embarrassment persisted until the 1950s when Hubble, Nicholas Mayall, and Sandage remeasured the distances to remote galaxies and found that they were even farther away than had been thought. That is, the universe was more expanded than Hubble's original measurements had indicated. This meant that going backward in time, the galaxies would take longer to come together than previously thought. The universe must therefore be older than Hubble's 1932 value.

The new measurements turned out to correspond to an age of five billion years, making the universe somewhat older than the solar system. Once again, the house of scientific cosmology was in order.

In 1958, Sandage published a further revision of galactic distances, putting the galaxies still farther out than the 1956 values. This result doubled the age of the universe a second time, bringing it to roughly ten billion years.

The latest episode is the 1972 announcement that galaxies are still farther away than Sandage thought in 1958, and the universe is still older. Currently a good guess for its age is thirteen billion years.

Is this result the last word? In the forty years since Hubble published his first value, the estimates of distances to remote galaxies have increased by a factor of ten, and the measured age of the universe has increased by the same factor. Yet each published value was claimed in turn by its authors to have an error no greater than 15 percent. Perhaps further increases are in prospect, but the consensus among astronomers is that another doubling is very unlikely. The final value for the age of the universe will probably lie in the range of ten to twenty billion years. More interesting than the precise age of the universe, however, is the extraordinary conclusion that our world began at a definite moment and has not been here forever. With this result, based on hard facts in astronomy, scientific cosmology comes full circle; its twentieth-century instruments and theoretical labors have produced a description of the history of the world that, like the Book of Genesis, begins suddenly, sharply, with an act of creation.

Robert Jastrow, director of the Goddard Institute for Space Studies in New York City, is also adjunct professor of geology at Columbia University and of earth sciences at Dartmouth College.

Australia is a land apart. Good thing, too. Or we wouldn't have Kookaburras, Kangaroos, Koalas, and a whole lot of other things you can only find Down Under.

Go to Melbourne's Royal Botanical Gardens, they're the finest in Australia. Visit the Sir Colin Mackenzie Sanctuary where the Platypus was first bred in captivity (that's that funny, furry, duck-billed creature that's actually a living fossil).

On Phillip Island see thousands of Fairy Penguins, the world's smallest. Be a guest at a hundred-year-old homestead. The owners are noted bird-watchers and they'll give you the drum* on our feathered mates. Laughing Kookaburras. Gallahs that flit about like tiny Charlie Chaplins (we Aussies call bad drivers "mug gallahs"). Willy Wagtails. Butcher-birds. Masked Owls. And outlandish kinds of parrots.

In Canberra go to the Tidbinbilla Nature Reserve. All sorts of Kangaroos, lots of them carrying their joeys*. Not to mention Swamp Wallabies, Ring-tailed Possums, Emus (those big silly birds that can't fly a lick), shy bush animals.

In Sydney take a ferry to the Taronga Zoo Park and Aquarium. Inside, fantastic water and wildlife. Outside a bonzer* harbor view, with Sydney's hundred-million-dollar Opera House looking like a mammoth space-age sailboat.

See the Koala Sanctuary in Brisbane. 150 cute slow-pokey Koalas, and cuddling is encouraged. And while you're there visit jungly Lamington National Park. Over 500 waterfalls, orchids thick as weeds, Lyrebirds (if you're lucky you can catch one in a courtship dance).

Naturally, you won't just be taking in our flora and fauna; you'll be enjoying our fine tucker*, and having a good drop* with us Aussies. We're a rare species, too. Don't know how to be unfriendly, so very quickly you become our mates. It'll be a beaut trip.

Just mail in the coupon and we'll tell you more about our reasonably-priced prepackaged wildlife tours. Of course, if you prefer an individual tour, your Travel Agent will gladly plan one for you.

***The Drum**/the truth ***Joey**/baby kangaroo ***Bonzer**/great ***Tucker**/food ***Good Drop**/drink

Australian Tourist Commission Dept. N3
1270 Avenue of the Americas, N.Y., N.Y. 10020
3550 Wilshire Blvd., Los Angeles, Calif. 90010

Already I'm wild for Australia's wildlife.
Please send me literature on
☐ Birds ☐ Flora ☐ Fauna
I'm interested in ☐ Group Tours
☐ Individual Itineraries

Name

Address

City State Zip

AUSTRALIA Where the good old days are now.

Celestial Events

by Thomas D. Nicholson

Sun and Moon The sun's southerly movement reaches its maximum rate by late August, although days longer than nights continue to warm the Northern Hemisphere. By September, the sun is approaching the equatorial plane, crossing it on September 23, the autumnal equinox, which marks the end of the northern summer and the beginning of fall.

Expect evening moonlight each month from a few days after midmonth, when the early evening crescent moon appears, to a few days after the beginning of the next month, when the nearly full moon is still in the sky almost all night. The phases are: August—new on the 17th, first-quarter on the 24th; September—full on the 1st, last-quarter on the 5th, new on the 15th, first-quarter on the 23rd; October—full on the 1st, last-quarter on the 8th, new on the 15th.

Stars and Planets The bright northern stars of summer (Altair, Deneb, and Vega) and their constellations (Aquila, Cyanus, and Lyra) persist as dominant features of the evening sky well into the autumn, setting after midnight as late as the beginning of November. Although autumn stars (as far east as Perseus and Taurus) are now well up in the east in early evening, the summer stars are at their best.

Mars still lingers on technically as an evening star until mid-October, but too low, too faint, and setting too soon after the sun to be seen. Jupiter joins it as an evening star on September 2, becoming the first bright planet in the dusk since June. Rising close to sunset, Jupiter remains in the sky till dawn and accompanies Saturn (well up in the south) and Venus (rising north of east before the sun) in greeting the dawn. Saturn becomes more prominent as a morning star in October, but Venus becomes less so; it probably rises too late by the end of September. Mercury is not well placed for viewing; even its evening elongation in early October is a poor one.

August 16: Venus is near the crescent moon this morning.

August 17: The perigee full moon will produce tides higher than normal. Mercury is in line with the sun, beyond it, and moving from the morning to the evening sky.

August 30: Moon is at apogee, farthest from earth.

September 1: Mercury and Mars are in conjunction. Jupiter will be near the moon all night.

September 5: Jupiter, at opposition, rises at sunset, sets at sunrise.

September 11: Saturn will be near the moon in the dawn sky.

September 14: The moon is at perigee, nearest earth.

September 23: Autumnal equinox. Autumn begins.

September 26: The moon is at apogee.

September 28: Jupiter rises near the moon about sunset. Through the night, the moon moves closer to the planet, passing nearest just before dawn..

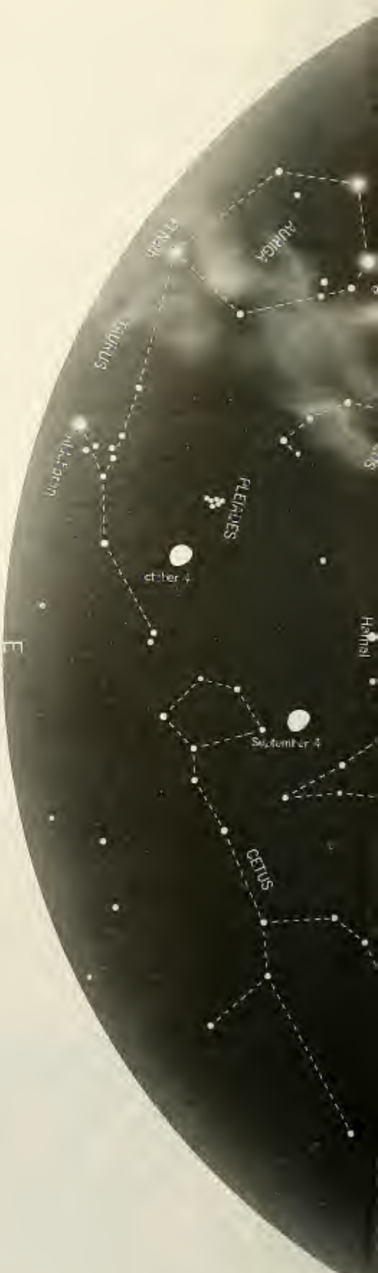
October 1: Mercury is at greatest elongation (distance) to the east (left) of the sun. But this is an unfavorable elongation; at sunset, the planet is only 8 degrees high.

October 8: Saturn rises close to the moon just before midnight, separating from the moon during the night.

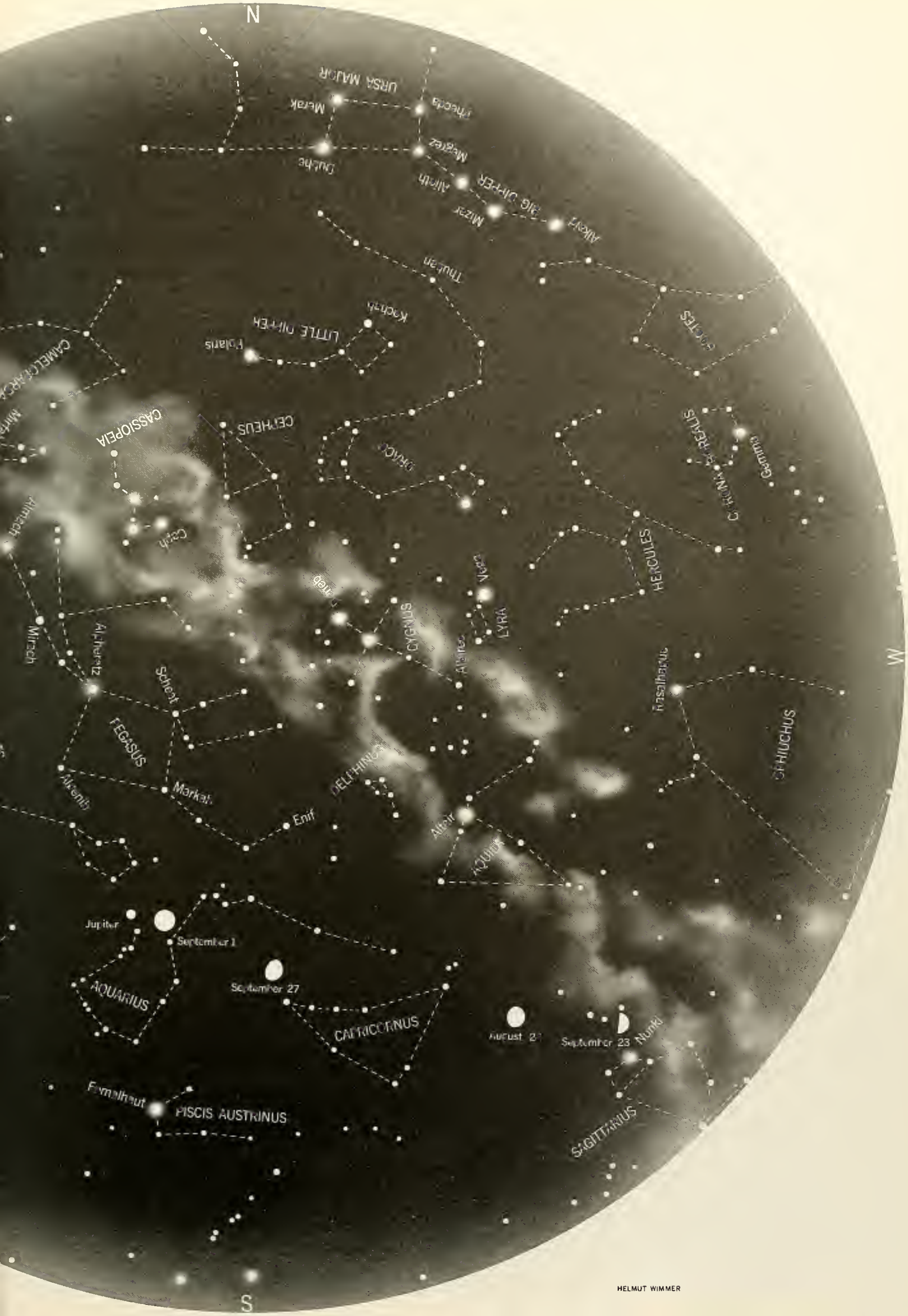
October 12: The moon is at perigee.

October 13: Mercury begins its retrograde motion.

October 14: Mars, in conjunction with the sun, finally leaves the evening sky and becomes a morning star.



★ Hold the Star Map so the compass direction you face is at the bottom, then match the stars in the lower half of the map with those in the sky near the horizon. The map is for 12:25 A.M. on August 15; 11:20 P.M. on August 31; 10:20 P.M. on September 15; 9:20 P.M. on September 30; and 8:20 P.M. on October 15; but it can be used for about an hour before and after these times.


N
URSA MAJOR
Merak
Phecda
Dubhe
Megrez
Alioth
BIG DIPPER
Mizar
Alkaid
Thuban
BOOTES
Kochab
LITTLE DIPPER
Polaris
CAMELOPARDALIS
CASSIOPEIA
CEPHEUS
DRACO
CORONA BOREALIS
Gemma
Caph
Almach
HERCULES
Deneb
Vega
LYRA
CYGNUS
Albireo
Mirach
Alpheratz
Scheat
Rasalhague
OPHIUCHUS
W
PEGASUS
DELPHINUS
Algenib
Markab
Enif
Altair
AQUILA
Jupiter
September 1
September 27
AQUARIUS
CAPRICORNUS
August 2
September 23
Nunki
Fomalhaut
PISCIS AUSTRINUS
SAGITTARIUS
S

HELMUT WIMMER

by Arthur W. Galston

The Membrane Barrier

The passage of substances into and through cells is one of the hottest subjects of biological research

In biology, as in all fields of human endeavor, there are fads. For reasons that are not always clear, certain subjects, modes of thought, and approaches to problems predominate at certain times, thereby influencing the direction in which the field develops. Now that the initial excitement over DNA, RNA, and protein synthesis seems to have died down somewhat, problems associated with the cell membrane are the current "fad" in biology and have come to dominate much of the thinking of cell biologists. It is not that the membrane is a new discovery, but merely that new techniques of investigation and a new appreciation of the importance of spatial organization within cell systems have made this cellular component a central focus for much that is exciting in modern biology.

The excitement is certainly not generated by what one sees when looking at a membrane through even the most powerful microscopes available. For the membranes that encase all cells—whether animal or plant—and all internal cellular units, or organelles, such as the nucleus, chloroplast, and mitochondrion, consist basically of only two layers of material separated by an apparently empty space. The layers always consist of proteins and fats, although these compounds differ in detail in different structures. The distance across the entire assembly is always uniform—about 10 nanometers, or one hundred-millionth of a meter. This is only about 1 percent of the cross-sectional diameter of even the smallest cells. Although small and inconspicuous, the membrane is one of the most important parts of the cell—without membrane integrity, no cell could long survive.

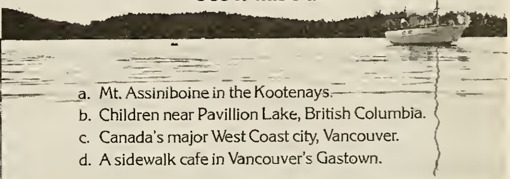
Certain cell membranes can be easily isolated in large quantities for chemical analysis. The best source of membranes to date has been the "ghosts" of mammalian red blood cells derived from rupturing these cells in water. When the cells burst, their contents spew out, and the envelope, which is practically pure membrane, can be removed from the other materials by high-speed centrifuging. Chemical analysis of the centrifuged membrane "pellet" reveals that it consists of about equal parts of two components—fats and proteins.

Most proteins are water soluble, while fats are oil soluble. Since oil and water do not mix, how can oil-soluble and water-soluble materials remain together in stable association in the membrane? The answer lies mainly in the special nature of the fats, or lipids, of the membrane. Like other lipids, they are built around a glycerol molecule and contain two chains of fat-soluble carbon atoms that are attached to one end of the glycerol. Also attached to the same glycerol molecule is a highly water-soluble portion of the lipid that terminates in a phosphate group. The resultant molecule, called a phospholipid, is a single, stable structure, one end of which is soluble in fat, the other in water. This dual solubility furnishes the molecular basis for the stable, fat-permeable and water-permeable membrane. When pure phospholipids are dropped onto the surface of pure water, they form layers one molecule thick, with the water-soluble ends of the molecules sticking down into the liquid, and the fat-soluble carbon chains sticking up in the air. When the phosopholipids are dropped onto oil, the reverse takes place. When they are dropped onto a medium composed of oil and water the phospholipid molecules partition themselves according to the solubility of each end, thus stabilizing the oil and water into an emulsion.

Proteins, which consist of long chains of amino acids, have both water-soluble, or hydrophilic, and water-rejecting, or hydrophobic, regions. When brought into contact with a phospholipid-stabilized emulsion, the protein molecule will twist and bend, orienting itself so that its hydrophilic parts are in the stabilized aqueous portion and its hydrophobic parts in the stabilized lipid portion of the emulsion. In this way, membranes can virtually assemble themselves into what appears to be a complex structure at the molecular level.

The membrane that encases all cells lies at the boundary between the cell and its external environment. Every molecule entering or leaving the cell must therefore deal with the barrier of the membrane. Just before the turn of the twentieth century, a physical chemist named E. Overton studied the penetration of various kinds of molecules into algal plant cells. He found that both fat-soluble and water-soluble materials enter the cell, but apparently through different pathways and by different mechanisms. Among fat-soluble compounds, the most soluble entered most rapidly; but among water-soluble compounds, the smallest molecules entered most rapidly. Overton concluded that the membrane must be a mosaic of fatty and aqueous pathways with the aqueous pathways being smaller than the fatty ones and thus tending to admit small molecules in preference to larger ones. Although Overton's mosaic idea has undergone many transformations and refinements, it remains essentially valid and is basic to the most modern models of the cell membrane.

A salient feature of this membrane is its differential permeability—the fact that certain kinds of molecules can penetrate it easily, others more slowly and with difficulty, and still others not at all. Because of this property, the membrane, situated at the doorway of the cell, determines, at least in part, which molecules can enter and which can leave the cell. But the

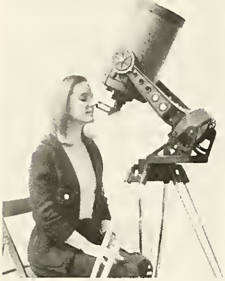


THIS IS BRITISH COLUMBIA, CANADA
More than just another country,
it's another world.
See it this Fall.

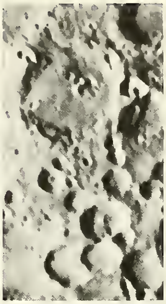
a. Mt. Assiniboine in the Kootenays.
b. Children near Pavillion Lake, British Columbia.
c. Canada's major West Coast city, Vancouver.
d. A sidewalk cafe in Vancouver's Gastown.

For more information contact British Columbia House, 585-3303 Wilshire Blvd., Los Angeles, California 09910; British Columbia House, Room 400, 100 Bush Street, San Francisco, California 94105; or write The British Columbia Department of Travel Industry, 1019 Wharf Street, Victoria, British Columbia, Canada V8W 2Z2.

Celestron® Multipurpose TELESCOPES



The Celestron 8, with equatorial wedge and tripod, a portable observatory for the serious amateur astronomer.



Lunar craterlets. A 1-sec. exposure with the Celestron 5 tabletop observatory.

Dust lanes in the Andromeda Galaxy. An 8-min. exposure with the Celestron 8-inch, f/1.5 Schmidt Camera.

Large observatory telescopes optically folded into compact portables. Razor-sharp Schmidt-Cassegrain optics. These telescopes really make high power worth using! Perfect for serious amateur astronomers, nature observers, educators. Ideal for field trips in astronomy, biology, geology, archeology, architecture and ecology.

Celestron 5. A 12-lb. tabletop observatory, bannister telescope. Observe or photograph moon, planets, nebulae. Inspect the wing feathers of a blue jay at 1,000 ft. (Base Price: $625) Celestron 8. Portable observatory for examining the polar caps of Mars, ever-changing belt structure of Jupiter, stellar spectra, filamentary detail of deep-sky nebulae at up to 500X. Also, the ultimate telephoto lens! ($895) Celestron 14. World's largest one-man-portable observatory scope! Reveals numerous subdivisions in Saturn's rings, dust lanes in remote spiral galaxies, yet easily fits into your compact car. ($3 600) Also available: Schmidt Cameras — 14-in., f/1.7 ($3,000); 8-in., f/1.5 ($710); 5½-in., f/1.65 ($565) . . . Cold Cameras . . . Complete astrophotographic labs.

WRITE FOR YOUR FREE COLOR CATALOG

CELESTRON	5″	8″	14″
Useful powers	25-300X	50-500X	50-850X
Light grasp (vs. eye)	188X	510X	1,760X
Photographic speed	f/10	f/10	f/11
Resolution (arc-secs.)	0.8	0.5	0.28
Weight (lbs.)	12	23	108

Celestron Pacific · 2835 Columbia / Box 3578-NH / Torrance, CA 90503

TRAVEL THE WORLD OF LINDBLAD

Traveling with
LINDBLAD IN INDIA
is an unforgettably beautiful experience.

Today India offers more to see than virtually anywhere else in the world. You will encounter richness and beauty. See the great architecture of the Moghuls. Travel the huge forests where you find tiger, rhino and incredible bird life. See the famous nature preserves. You will come upon different life styles of many people, rich and poor. You may shop in bazaars reminiscent of the days of Rudyard Kipling. And you will travel in small groups. Quality is the key word to Lindblad's well-planned India Expeditions. We offer the Himalayan Nature Tour and Incomparable India. On our program also is Bhutan and Burma as well as the ever-popular Expedition to the Borderlands of Tibet. The Kashmir Extension is available to all except Bhutan and Burma Excursion. **Air-India** will fly you to these tours in superb comfort. Please write for our "Lindblad in India" brochure.

LINDBLAD TRAVEL, INC.
Dept NHIN874
122 East 55th Street, New York, N.Y
(212) 751-2300

membrane is much more complex than that; it has an inside and an outside, and both have an amazing capacity for change. To appreciate this, we must consider the different ways in which substances penetrate the membrane. In Overton's experiments, the penetration process seems to involve only simple diffusion. If there is a high concentration of a given substance outside the cell and a low concentration inside the cell and the membrane contains a pathway for this compound, the substance will tend to enter the cell. Conversely, if there is a high concentration of the substance inside the cell and a low concentration outside, the compound will tend to leave the cell.

For many water-soluble substances, entry into the cell first involves actual attachment to a specific site on the membrane, probably the location of a specific protein. A simple experiment will illustrate. Let us take a cell, immerse it in a solution of a simple salt such as potassium chloride, and measure the rate at which potassium enters the cell. If we now add to the external potassium chloride solution a closely related salt, lithium chloride, the potassium will enter the cell less readily than previously. By varying the ratio of potassium to lithium in the external medium and measuring the rate of penetration of each, we can prove that the two salts are competing for space at the same membrane pathway. It has been found that sodium chloride, another closely related salt, enters the cell by yet another pathway, at which other substances in turn compete with it for entry. From experiments like this, we can conclude that the aqueous part of the mosaic of the cell membrane has specific transport sites for the entry of particular materials; each site is presumed to owe its specificity to the presence of a single protein or group of proteins.

The penetration of some substances, however, is not a matter of passive diffusion and entry in accordance with the concentration, but may involve the performance of work by the cell. For example, in order to pass through certain membranes, ordinary sugar, or sucrose, must first be transformed chemically by the attachment of a phosphate group. The sugar traverses the membrane in the form of sucrose phosphate, and once it has entered the cell it is reconverted to sucrose by a reaction that splits off the phosphate group. The phosphate is therefore a carrier for the entry of sucrose into the cell, but the work of adding and eliminating the phosphate group involves energy-using chemical reactions. Because of the external location of the phosphate-attaching reaction and the internal location of the phosphate-removing reaction, sucrose transport through the membrane can proceed in only one direction—outside to inside. Hence, such a membrane is said to have "directionality."

The permeability of a membrane to a given material is not a fixed property but may change in response to a number of physical and chemical stimuli. Hormones, for example, frequently cause the cell to alter its uptake or release of a particular dissolved substance, or solute. In addition, the solute itself can induce the cell to change its permeability characteristics. Usually, the cell responds to the latter stimulus by making new proteins in the membrane, which combine with the solute in question to facilitate its entry. Through this means, a cell can handle one substance at a time. Given two substances in a mixture, certain microorganisms will first take up all of one of them before absorbing any of the other. One substance evidently prevents absorption of the other by inhibiting formation of the specific protein needed for its uptake. Membranes thus have a dynamic quality and are constantly changing the nature and location of their absorption sites.

The mitochondria and chloroplasts are cellular substructures that deal with the conversion of energy. In the mitochondria, found in all cells, fuels such as sugar and organic acids are oxidized. The energy released in the process is captured in the special phosphate bonds of energy-rich compounds like adenosine triphosphate, or ATP, which is manufactured by the mitochondria. It is ATP that, among its other activities, furnishes the phosphate group that moves sucrose across the cell's surface membrane as sucrose phosphate. ATP is therefore a kind of "energy currency" that is spent when cellular work needs to be done. ATP is also made in the chloroplast, the or-

Here's How You Can Sponsor A Child

Here's What You Do

- Fill out your name and address on the coupon.
- Indicate your preference of boy or girl, and country.

Or . . .

- Check the box marked "Choose any child who needs my help," allowing us to assign you a child from our emergency list.
- Enclose your first monthly check. The cost is only $15 each month to help a child who needs you.

Here's What You Will Receive

- In about two weeks you'll receive a Personal Sponsor Folder with photograph and information on the child you sponsor and a description of the project where the child receives help.
- Later on . . . a "welcome letter" from the overseas field office.
- Progress reports on the child when you request them.
- A Christmas greeting from the child.
- The opportunity to write directly to the child. You will be given the mailing address and detailed instructions on mail to your child's country.
- Letters from the child answering your correspondence. You receive the child's original letter and an English translation from an overseas office.
- And the satisfaction that comes from helping a deserving child.

Here's What Your Sponsored Child Receives

- In children's homes: supplementary food, clothing, medical care, and dedicated housemothers.
- In Family Helper Projects: school supplies and clothing, medical assistance, emergency food and shelter, and family guidance from a trained child care worker.
- Special aid depending on the country and the type of project.
- Psychological support because the child knows *you* care.

Sponsors are urgently needed for children in: Brazil, India, Guatemala and Indonesia.

Write today: Verent J. Mills

CHRISTIAN CHILDREN'S FUND, Inc. Box 26511, Richmond, Va. 23261

I wish to sponsor a ☐ boy ☐ girl in

(Country)________________

☐ Choose any child who needs my help.

I will pay $15 a month. I enclose first payment of $________. Send me child's name, story, address and picture.

I cannot sponsor a child but want to give $________.

☐ Please send me more information.

Name________________

Address________________

City________________

State________________Zip________

Registered (VFA-080) with the U.S. Government's Advisory Committee on Voluntary Foreign Aid. Gifts are tax deductible. Canadians: Write 1407 Yonge, Toronto 7.

NH1380

YOU *SEE* MORE WITH QUESTAR

A stunning composition photographed by Questar without tower or stalking blind; just the 500 feet between Questar (in cover shot) and water turkey kept this nervous bird sitting quietly on his perch for the picture. Part of the print cropped off for this space actually showed a cobweb holding captured insects. Tri-X, 1/250 second.

Questar's new Fast Focus makes wildlife shots easier than ever, and the Carpod lets you, too, sit quietly while you take pictures like this from inside your car.

For a complete description of photo-visual Questar, the world's finest, most versatile telescope, send for our booklet of photographs by Questar owners; $1 for mailing on this continent; by air to S.A., $2.50; Europe and N. Africa, $3; other areas, $3.50. QUESTAR'S Florida showroom is at Q Camera in the Daytona Beach Mall.

© 1974 Questar Corporation

QUESTAR

Box T60, New Hope, Pa. 18938

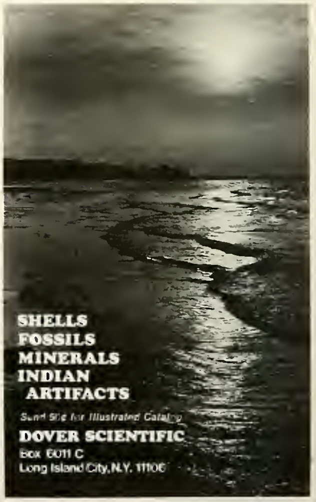
ganelle in plant cells in which photosynthesis takes place. Highly structured specific membranes are involved in the chemical reactions that take place in both the mitochondria and chloroplasts. The resultant flow of elementary particles—electrons and protons—through particular protein pathways in the organelle membranes can cause the formation of ATP. But if the membrane structure is disrupted by mechanical or chemical means, ATP formation no longer occurs, even in the presence of all the necessary components. The integrity of membrane structure is therefore crucial.

Membranes have recently acquired a new importance in cancer research. If ordinary animal cells are placed in a chemical medium favorable to their growth, they will divide and grow until they cover the entire surface with a single layer of cells. Then, due to a mysterious process called "contact inhibition," they stop growing. When cancerous cells are placed in a similar medium, they show no contact inhibition but grow and pile up on top of one another without stopping. This leads to the theory that surface membrane proteins are involved in the normal cessation of growth and that cancer cells may have abnormal surface proteins. If this theory is correct, then immunological approaches to cancer would seem appropriate.

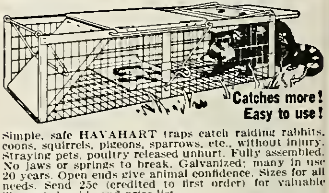
The surface membranes of both normal and cancerous cells are in a state of constant activity, which is sometimes visible by time-lapse photography under a microscope. They are able to send out projections that can surround and engulf ambient particles. In the case of the single-celled amoeba, the particles may be food; with mammalian cells, the particles may be invading bacteria being combatted by a white blood cell. When the captured particle is brought back to the surface of the ingesting cell, the membrane pinches together, cutting off the projection, or vesicle, surrounding the foreign particle. The vesicle then moves to the interior of the cell, where it can be digested by cellular enzymes. It is apparent that although the cell membrane may exclude many small molecules through differential permeability, it can ingest relatively large particles. Even large pieces of DNA can enter cells by this process, leading to the possibility of direct genetic transfer from one cell to another.

Certain cells, like the rods and cones in the retina of the eye and the nerve cells that transmit electrical stimuli, have special membranes designed for transforming chemical reactions into electrical signals. Nerve cells, for example, show electrical changes because the membrane periodically changes its electrical charge and releases large quantities of salts through diffusion channels. The channels then close up, and the salt accumulation in the nerve cell is restored by a process that involves a so-called pump, or protein, that uses ATP energy to move one salt across the membrane. Such pumps are present in all cells, and research into how they work is one of the most fascinating aspects of the current inquiry into the cell.

Columnist Arthur W. Galston teaches biology at Yale University.



CATCH ANIMAL RAIDERS!



Catches more!
Easy to use!

Simple, safe HAVAHART traps catch raiding rabbits, coons, squirrels, pigeons, sparrows, etc., without injury. Straying pets, poultry released unhurt. Fully assembled. No jaws or springs to break. Galvanized; many in use 20 years. Open ends give animal confidence. Sizes for all needs. Send 25c (credited to first order) for valuable illustrated guide and price list.

HAVAHART, 158 Water St., Ossining, N. Y. 10562

Please send new guide and price list.

Name ________________________

Address ____________________ Zip ______

WE WANT YOU TO BE ABLE TO CONTROL YOUR INSECT PROBLEMS WITHOUT DAMAGING THE ENVIRONMENT

FOR THIS REASON, in our line of RAID flying insect control products, we adopted only the safest of all known insecticides, the Pyrethrins, plus such non-persistent synthetics as Neopynamin and d-trans-Allethrin, as active ingredients.

To control crawling insects such as roaches effectively, a product must have some residual effect. We make such products for those who have need of them. But we make them with carbamate and organophosphorous active ingredients, all of which degrade rapidly enough to pose minimal environmental hazards to plant, animal and bird life.

Further, we recommend that our products be used only for in-home and near-home situations, such as private yards and gardens.

Finally, we do not use DDT, Lindane, Dieldrin, or other "hard" chlorinated hydrocarbons, in any of our products.

We want you to be able to control your insect problems. But not at the expense of our environment.

Raid®

S. C. Johnson & Son, Inc., Makers of Raid Insecticides

©1971 S. C. Johnson & Son, Inc., Racine, Wisconsin 53403 Printed in U.S.A. All rights reserved. RAID is a trademark.

Birding by the Book

Sooner or later you too must succumb to the fascination of birds. Some summer afternoon you will be startled by an unfamiliar sunshine sprite swinging musical garlands from tree to tree; some spring dawn you will come upon a salt-white bird (a heron?) poised at a silent shore. Perhaps some evening it will be a flight of winged arrows stitching invisible Jackson Pollack traceries in the air. Suddenly you will be thrilled and moved: there is so much to know about this world we live in—and so little time!

For me it was a field of oxeye daisies in misty morning light, with one red-patched blackbird cruising over it. That vision wakened me to birdlife and a world of endless mystery, surprise, wonder, and joy. I was eleven.

I did what you will do: I got myself a pair of binoculars, to bring distant unknowns closer, and a book with pictures to tell me what they were. I still have that little pocket guide by Chester A. Reed, published (then) by Doubleday Doran, and entitled simply *Land Birds*. There was a companion volume, too, called *Water and Game Birds*, and together they pictured and described all the species I was to see in my first year of bird watching. The pages are torn and foxed now, but each has a date on it, the date of my first sighting: each a triumph and a celebration.

The Reed guides are still available, in umpteenth reprint (Doubleday, $3.95), but we have come far since then, and there are better "field guides" for almost any region you may inhabit or plan to visit. Handsomely illustrated, with matching texts, they make bird

ADRIAN DIGNAN

by Robert Arbib

identification almost as simple and foolproof as possible. (Too simple, perhaps, because some identifications will always be difficult and a few almost impossible.)

For North America, the book that revolutionized bird identification and promoted bird watching more than any other is Roger Tory Peterson's famous *A Field Guide to the Birds* (Houghton Mifflin, $5.95; paperback, $3.95). Peterson's guide was the first to stress diagnostic field marks—those exclusive features to look for in deciding between very similar birds. Every species in eastern North America was illustrated, and confusing plumages (such as those of the warblers in fall) were shown side by side, with the subtle differences pointed out. It had never been done before.

Bird watching took a quantum jump with this field aid; it was followed in due course by Peterson's *Field Guide to Western Birds* (Houghton Mifflin, $5.95; paperback, $3.95) and much later by a special guide for Texas ($6.95). Doubleday followed with the Audubon Field Guides, by Richard H. Pough, illustrated by a fine young artist, Donald Eckelberry. The Pough-Eckelberry guides, *Audubon Water Bird Guide* ($6.95), *Audubon Land Bird Guide* ($5.95), were on a slightly different plan, with more text, larger illustrations, and with more plumages shown.

These were the standard field guides for North America until 1966, when Golden Press inaugurated a new generation of guides, on an entirely different model, with *Birds of North America*, by Chandler S. Robbins, Bertel Bruun, and Herbert S. Zim ($5.95; paperback, $3.95) and marking the debut of a new artist of first quality, Arthur Singer.

Here, for the first time, in one marvelously compact volume, every species of bird found north of Mexico was shown in color, each on the page facing the text, with tiny range maps and song diagrams. It was an immediate sensation, and together with the Peterson guide for your region, should be the keystone of your bird bookshelf. (A brand new Peterson eastern guide, much needed, is in preparation.)

Once you have this start, you will want to know where and when to go looking for the birds of your region, beyond your backyard or the nearest park. More and more regions of America are the subjects now of bird Baedekers: there are too many to list. The two-volume work compiled by O. Sewall Pettingill (Oxford University Press, $10.00 each) called *Guide to Bird Finding East* [and *West*] *of the Mississippi*, now somewhat antiquated, is still a useful guide. More typical and more detailed perhaps are books like *Enjoying Birds Around New York City* (Houghton Mifflin, $2.45), with location maps, annual calendar, and thumbnail sketches of 200 places to see birds from Montauk to Slide Mountain. There are now such publications for areas from Maine to Panama and from the state of Washington to Texas. A finding guide on a habitat, rather than geographical, plan is the ingenious new book by Thomas P. McElroy, Jr., entitled *The Habitat Guide to Birding* (Knopf, $8.95). It tells you what birds to look for in the various habitats of the United States and Canada, and at what seasons of the year.

But our encyclopedic knowledge of bird life today can no longer be crammed into vest-pocket books, and you will soon want to add books with broader scope and more detailed information. Your shelf has begun with the field and bird-finding guides; it is time now to add, if available, the state book for your state. Many states have, or have had, elaborate books with lavish color plates and detailed species treatments; many are out of print and collector's items, like E.H. Forbush's *Birds of Massachusetts and Other New England States* (Massachusetts Department of Agriculture, 1925–29) with paintings by the famous L.A. Fuertes, sets of which fetch $120 and up today. The original *Birds of New York*, by E.H. Eaton (N.Y. State Museum, 1914–18), with the earlier work of Fuertes sold for a few dollars a set. A much-needed, new, one-volume *Birds of New York State*, by John Bull (Doubleday, late 1974), will probably cost $30. But it will summarize perhaps ten times the knowledge that Eaton had available to him. Most other states and provinces have books—among the newer ones are Alabama, Florida, California, Kentucky, Oklahoma, Alberta, Colorado, and Washington. Books are now in preparation for several other states.

If you cannot obtain the latest book for your state, a highly recommended alternative would be *The Audubon Illustrated Handbook of American Birds*, by E.M. Reilly (McGraw-Hill, $12.95), which covers the continent in one massive volume. I might then add *Birds of the World*, by Oliver L. Austin, Jr. and Arthur Singer (Golden Press), as an introduction to all the world's bird families. It is a most beautiful volume but now difficult to obtain.

In the tradition of *Rascal* and *The Yearling*

DRIFTER
A NOVEL BY
DANIEL P. MANNIX

Set against the background of southern California's deserts, mountains and coast, this is a heartwarming story of a boy who lovingly rears an orphaned sea lion pup.

"Solid, touching and at times exciting. It's also deeply informed on the world of wild animals." —*Publishers Weekly*

$6.95 at booksellers

READER'S DIGEST PRESS
distributed by E.P. Dutton

The hero of this story is an eagle—magnificent, indomitable ... and doomed

— if we don't do something about it

■ In this haunting and powerful book, one of the nation's foremost wildlife authors tells the story of one eagle's life from birth to death: his graceful flight, his violent quest for food, the ritual of mating and nesting, the constant presence of sudden death — both natural and at the hands of the ultimate predator, man.

THE LAST EAGLE

by BEN EAST • Illustrated. $5.95, now at your bookstore, or send check or money order to CROWN PUBLISHERS, 419 Park Ave. South, N.Y.C. 10016. Crown

It is summarized in Austin's *Families of Birds* (Golden Press, $5.50; paperback, $1.95).

The next additions, surely, should be general works on ornithology. A fine popular beginning and bargain is *The Birds*, a "Life Nature Library" book by Roger Peterson (Time-Life, $3.95), but for a comprehensive college-level treatise, I would choose *The Life of Birds*, by Joel Carl Welty (Knopf, $15.00). Add too, if you can find a copy, the best one-volume encyclopedia on birds, *The New Dictionary of Birds*, edited by A. Landsborough Thomson (McGraw-Hill). It is temporarily out of print, but a new printing has been rumored for some time. It is a 900-page encyclopedia.

Now that your bookshelf is well launched, you may want to acquire some of the books on specialized subjects or on single families (or even species) of birds of particular interest to you. Highly recommended are such books as *The Migration of Birds*, by Jean Dorst (Houghton Mifflin, $6.75), *A Study of Bird Song*, by Edward A. Armstrong (Dover Press, $4.00), *The Flight of Birds*, by J.H. Storer (Cranbrook Institute of Science), and *Bird Display and Behavior*, by E.A. Armstrong (Dover Press, $3.50).

When it comes to families of birds or individual species, you might start with the old but excellent *Ducks, Geese and Swans of North America*, by Francis H. Kortright (Stackpole, $7.50), or such new books (among many) as *Owls of the World*, by John Burton (Dutton, $17.50), *The Life of the Hummingbird*, by Alexander Skutch and Arthur Singer (Crown, $9.95), *Grouse and Quails of North America*, by Paul Johnsgard (University of Nebraska Press, $25.00), *The Swans*, by Peter Scott (Houghton Mifflin, $15.00), *Studies in the Life History of the Song Sparrow*, by Margaret M. Nice (2 vols., Dover Press, $2.50 each), a seminal work, and *The Herring Gull's World*, by Niko Tinbergen (Harper & Row, paperback, $2.95). For popular reading, the well-illustrated "Living World" series brings closeups of certain bird species. Each entitled *The World of . . .* it includes, among bird subjects, the swan, the Canada goose, the wood duck, the red-tailed hawk, the great

Enjoyment For All

Attract hummers with a Brown's Original "Hummy-Bird Bar" ®. A favorite for 19 years. Durable and long-lasting. Watch them sip from this 4-way see-thru feeder cup. Glass bottle; detachable perch; beeproof; no drip or rust. Guaranteed. Instructions. $3.50 plus 50¢ hndling & pstge ea. Add 21¢ tax in Calif. No CODs. HUMMINGBIRD HEAVEN, 10726-N Samoa Ave., Tujunga, CA 91042. Made in U.S.A.

KOMURA BROOKS 2 x TELE EXTENDER
MULTICOATED 4 ELEMENT
DOUBLE FOCAL LENGTH AT A FRACTION OF CAMERA LENS PRICE
FOR HASSELBLAD BRONICA MAMIYA RB 67 PENTAX 6 x 7

BURLEIGH BROOKS OPTICS, INC. • 44 BURLEWS CT., HACKENSACK, N.J. • 201-489-1300

IDENTIFIED PETRIFIED WOODS. World's largest supplier of *named* petrified woods including rare, tropical, ancient and extinct species. Finest quality mirror-polished display specimens. Advanced collector, decorator and museum pieces. Rare petrified cones, seeds, nuts, ferns and fossil leaves. Free price list. BEAVER-HOOD CO., P.O. Box 1481, Dept. G, Portland, Oregon 97207.

out of print, scarce, rare NATURAL HISTORY BOOKS

The Book Chest

Botany, Zoology, Orchidology, Ornithology, Entomology, Ichthyology, Herpetology, etc.
CATALOGUE 7 AVAILABLE

19 Oxford Place/Rockville Centre, New York 11570

ENCHANTING ISLES of the EAST

A trip unique in the world of travel—to Tana Toradja, "land of the heavenly kings"—to incredible islands of Indonesia, the Philippines and Malaysia. Small select groups. Brochure your agent or

WORLD TRAVEL ASSOCIATES, INC.
219 Palermo Ave. Coral Gables, Fla. 33134

NATURE ON STAMPS

The BIRDS & the BEES & the ANIMAL KINGDOM on GENUINE POSTAGE STAMPS.

* SAMPLES & APPROVALS – $1
Satisfaction Guaranteed

Mil Med Stamps
P.O. BOX 297-NH AURORA, CO. 80010

Carry your darkroom!

B & J Changing Bag!

Load . . . Change . . . even process your film in broad daylight with light-tight B & J bags. Five sizes to 34 x 60"—the original and still the greatest!

Write for details to:
Burke & James inc.
44 Burlews Ct., Hackensack, N.J. 07601

horned owl, the gull (Lippincott, about $5.95 each). More recently there have been a spate of books, beautifully illustrated and lavishly printed, such as the now rare *Shorebirds of North America*, by Gardner Stout, Peter Matthiessen, and Ralph Palmer, with the superb paintings of Robert Clem (Viking Press, $22.50); *Curassows and Related Birds*, by Jean Delacour and Dean Amadon (American Museum, $21.00); *Francis Lee Jaques. Artist of the Wilderness World*, by Florence Page Jaques (Doubleday, $25.00), a gem; and one of the most beautiful bird books we have ever seen, *Parrots of the World*, by Joseph M. Forshaw, illustrated by William T. Cooper (Doubleday, $65.00). There are many others in this category. None of the aforementioned books are inexpensive, but some are priced lower than they would be if they had not been sponsored, in part, by generous patrons.

Two more time-honored works should be mentioned. One is the authoritative, if out of date in many details, *Check-List of North American Birds*, Fifth Edition (American Ornithological Union, $8.00), the standard authority on taxonomy (bird classification); and A.C. Bent's monumental twenty-three volume *Life Histories of North American Birds*, the most comprehensive treatment of the lives of North American birds ever published and now in truly bargain Dover reprints ($2.50–$5.00 per volume).

Now, if you have a garden, there are a number of useful guides for feeding, watering, and providing homes for birds. We recommend three books: *Songbirds in Your Garden*, by John K. Terres (Crowell, $6.95), *The New Handbook of Attracting Birds*, by Thomas P. McElroy, Jr. (Knopf, $5.95), and most immodestly, *The Hungry Bird Book*, by Robert Arbib and Tony Soper (Taplinger, $4.95; Ballantine paperback, $.95).

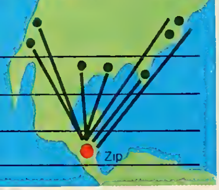
In addition to your texts, field guides, reference books, and art books, you should add one or two works that sample the fine writing on birds published over the years. Two that come to mind are *The Bird Watcher's Anthology*, edited by that man Peterson again (Harcourt Brace Jovanovitch); and *A Treasury of Birdlore*, edited by Joseph Wood Krutch and Paul S.

There are 21 different countries in Latin America, but in one country you can see what most of them are famous for.

Guatemala

Native handcrafts
Ancient Indian civilizations
Lakes and volcanoes
Vast cattle lands
Spanish colonization
Ultra-modern cities

See your travel agent or write:
Guatemala Tourist Commission
929 Sunrise Lane, Ft. Lauderdale, Florida 33304
Telephone (305) 565-1828
6A. Avenida 5-34, Zona 1, Guatemala City, Guatemala,
Central America



Name

Address

City

State Zip

If you're thinking about going to see some part of Latin America, come to Guatemala and see it all.

GIT tours for 4 days and 3 nights start at $196.00 from Miami and New Orleans. From Los Angeles $321.00. From Houston $253.00.

Donna Westerman

FREE TO NEW DEFENDERS *twelve 7″ x 7″ full-color collector prints handsomely bound in our exclusive 1975 Endangered Species Calendar. It's yours for joining one of the nation's oldest, most respected ecological organizations. Minimum annual dues of $7.50 include subscription to the bimonthly Defenders magazine.*

Defenders
OF WILDLIFE
INTERNATIONAL

Defending Wildlife Since 1925

A nonprofit, educational organization dedicated
to the preservation of all forms of wildlife.
Louis Barassi, President

2000 N Street, N.W., Washington, D.C. 20036

1975 Endangered Species Calendar

FREE

when you join

Defenders
OF WILDLIFE
INTERNATIONAL
Washington, D.C. 20036

Defending Wildlife Since 1925

Defenders of Wildlife International
2000 N St., N.W., Washington, D.C. 20036

I'll join Defenders. Bill me $7.50, the minimum annual dues, and send me the bimonthly Defenders magazine for one year. As a bonus for joining Defenders I will receive the 1975 Endangered Species calendar.

Name ____________________

Address ____________________

City ____________________

State __________ Zip __________

FIRST CLASS
Permit No. 5515-R
Wash., D.C.

BUSINESS REPLY MAIL

No Postage Stamp Necessary if Mailed in the United States

POSTAGE WILL BE PAID BY

DEFENDERS OF WILDLIFE
2000 N Street, N.W.
Washington, D. C. 20036

N

Eriksson (Eriksson, $7.95). Which will lead you back to search out the originals by John Burroughs, Elliott Coues, Thoreau, and other master writers.

With a shelf lined with the books recommended here, you are well on the way to a fine bird book library, and from here on additions are up to you. Perhaps your travels will take you to other parts of the world. For Europe there are now three fine field guides: the earliest, *A Field Guide to the Birds of Britain and Europe*, in the Peterson series (Houghton Mifflin, $7.00); *Birds of Europe*, by Bertel Bruun and Arthur Singer (McGraw-Hill, $6.95); and *The Birds of Britain and Europe*, by Hermann Heinzel, Richard Fitter, and John Parslow, on roughly the same format, but including eastern Europe, the Middle East, and North Africa (Lippincott, $7.50). All can be useful, particularly to easterners, in identifying strays from overseas.

Where are you going? West Indies? James Bond (Houghton Mifflin, $8.95). Mexico? A splendid new Peterson (Houghton Mifflin, $8.95). Trinidad? A brand new guide by Richard ffrench (Livingston, $12.50). Venezuela?—soon. East Africa? John Williams (Houghton Mifflin, $8.95). New Zealand? Guatemala? Seychelles? Galápagos Islands? Guides are here now or soon to come. And don't forget the vast ocean spaces where the albatross and the kittiwake play. That old indispensable *Birds of the Ocean*, by W. B. Alexander (Putnam, $5.95), is still in print, with at least three new oceanic bird guides in the offing.

We don't want to end this brief guide without mention of the book you must have (if loose, unbound, boxed pages can be called a book), *The Birds of America*, by John James Audubon. It has recently been reprinted in elephant folio size, on fine paper, in brilliant color reproduction—every single plate found in the original—at the truly bargain price of $5,940 (Johnson Reprints). But hurry—it's a very limited edition.

Robert Arbib writes for the National Audubon Society and also edits their bimonthly magazine American Birds. *His book,* The Lord's Woods, *won the John Burroughs medal as the outstanding nature book of 1972.*

FRANKLIN RUSSELL
SEASON ON THE PLAIN

By the author of *Watchers at the Pond* —a highly original look at the many creatures that inhabit the East African plain

Combining the narrative powers of the storyteller with the scientific knowledge of the naturalist, Franklin Russell brilliantly recreates and explains life on the African plain—its animals, birds and insects, their dependence on each other, and the many forces that affect them.

$8.95 at booksellers

READER'S DIGEST PRESS
distributed by E.P. Dutton, 201 Park Ave. South, New York, N.Y.

STOP THE WORLD

I want to take a picture!

If you are a camera-fan, you probably have wished the world would slow down a bit — especially during your vacation. On a Thru The Lens Photo Adventure it does!

For 22 years we have planned and operated a world-wide travel program for photo-hobbyists. Our itineraries are leisurely, our groups are small, and our leaders are top photographers.

If you would like to improve your photography and see some of the most interesting parts of the world while doing so, please join us!

FOR INFORMATION WRITE:

THRU THE LENS TOURS, INC.
P.O. Box 4516-N • 5301 Laurel Canyon Blvd.
North Hollywood, CA 91607 • (213) 877-0181
CABLE: LENSTOUR

$$$$$200$$$$$

Fly Sabena to Belgium's Bonus Days.

You get a wonderful welcome called Belgium's Bonus Days when you fly to or from Europe via Sabena's non-stop scheduled jetliners.

In seven fascinating Belgium cities, you can get up to $200 worth of free treats courtesy of the Belgian National Tourist Office.

For instance, free Avis mileage, a free night with breakfast in a top hotel, free opera, ballet, horseracing, casinos, and museums.

You also receive discounts for dining, sightseeing, and travel on Belgian trains.

Ask your travel agent, call Sabena (see Yellow Pages), or fill in the information below and send it to Sabena Belgian World Airlines, Holiday Abroad Manager, 125 Community Drive, Great Neck, N.Y. 11021.

HOLIDAY® ABROAD SABENA belgian world airlines

Name__________
Address__________
City_____ State_____ Zip_____
My travel agent is__________

NHO

$$$$$200$$$$$

AMERICA'S
MOST POPULAR
TELESCOPES

For over 20 years UNITRON Refractors have been the overwhelming choice of the amateur astronomer and school observatory. Exploring the skies with a telescope is a relaxing and educational diversion for the whole family—a hobby which is especially meaningful in the space age. UNITRON offers a complete line of 22 time-proven telescopes as well as many unique accessories to increase observing pleasure. All are available for purchase using our Easy Payment Plan.

A free UNITRON Catalog is yours for the asking.

Name__________
Address__________
City_____ State_____ Zip_____

S-21

UNITRON
SCIENTIFIC, INC.
66 NEEDHAM ST., NEWTON HIGHLANDS, MA 02161

ENDANGERED SPECIES PAPERWEIGHTS

Val St. Lambert interprets the endangered Rocky Mountain goat and the American bison in beautiful lead crystal paperweights. They're copper-wheel engraved and made in Belgium. Part of a limited edition of 1,000, each one is signed and numbered.
Rocky Mountain goat, #2697A.
Bison, #1350A. 55.00 each.
(1.85 postage and handling).

The Horchow Collection
FORMERLY THE KENTON COLLECTION

P. O. Box 34257, Dept. 0198S
Dallas, Texas 75234

☐ I've enclosed $1.00 for a year's subscription (6 issues) of the Horchow Collection Catalogues

Additional Reading

TIJGER (Page 12)

THE INCONOGRAPHY OF MANHATTAN ISLAND. Vol. I–VI. I. N. P. Stokes. Arno Press, Inc., New York, 1926.

DOCUMENTS RELATIVE TO THE COLONIAL HISTORY OF THE STATE OF NEW YORK. Vol. I. J. R. Brodhead. AMS Press, Inc., New York, 1887.

THE PREHISTORY OF THE NEW NETHERLAND COMPANY. S. Hart. City of Amsterdam Press, Amsterdam, 1959.

ANCIENT FARMERS (Page 42)

THE NEGEV. M. Evenari, et al. Harvard University Press, Cambridge, 1971.

EXCAVATIONS AT NESSANA. Vol. 3, Non-Literary Papyri. C. J. Kraemer, Jr., et al. Princeton University Press, Princeton, 1958.

THE DESERT OF THE EXODUS. E. H. Palmer. Harper and Brothers, New York, 1872.

THE SPIRAL WAY (Page 50)

ON GROWTH AND FORM. D'A. Thompson. Cambridge University Press, New York, 1961.

MATHEMATICAL SNAPSHOTS. H. Steinhaus. Oxford University Press, Inc., New York, 1969.

THE SCIENCE OF MOIRÉ PATTERNS. G. Oster. Edmund Scientific Company, Barrington, 1969.

SUN, SAND, SEA LIONS (Page 56)

MAMMALS OF THE SEA. S. H. Ridgway, ed. Charles C Thomas, Publisher, Springfield, Ill., 1972.

THE BIOLOGY OF MARINE MAMMALS. H. T. Andersen, ed. Academic Press, Inc., New York, 1968.

SEALS OF THE WORLD. G. Maxwell. Houghton Mifflin Company, Boston, 1968.

COMPARATIVE PHYSIOLOGY OF THERMOREGULATION. Vol. III. G. C. Whittow, ed. Academic Press, Inc., New York, 1973.

DRIFTWOOD FANTASY (Page 72)

EPHEMERAL FOLK FIGURES. A. Neal. Clarkson N. Potter, Inc., New York, 1969.

THE DYNAMICS OF CHANGE. D. Fabun, ed. Prentice-Hall, Inc., Englewood Cliffs, 1967.

ARTISTS IN SPITE OF ART. R. G. Carraher. Van Nostrand Reinhold Company, New York, 1970.

LIVE IN THE WORLD OF TOMORROW...TODAY!

A BETTER LIFE STARTS HERE

(And our FREE CATALOG is packed with exciting and unusual ecological & physical science items—plus 4,500 finds for fun, study or profit . . . for every member of the family.)

ERECT A "PRO" WEATHER STATION

Match your forecasting skill with anyone! Set up permanent meteorology sta. for reliable readings: windspeed, precipitation, barometric pressure, temp., humidity; get wind-chill, cloud types. Top qual. equipt.: rooftop remote reading pneumatic windspeed ind.; 11" rain gauge; holosteric barometer (inches, etc.); hi-lo self register thermometer; wet-dry bulb hygrometer. More!

No. 80,216E (w/372 PG. LOG)..............................$59.95 Ppd.

BEGINNER'S KIT: COMPL., LOW COST

Stock No. 71,022E..........................$17.00 Ppd.

AUTHENTIC SCALED WINDMILLS

Real-thing replicas show wind direction, wheel silently revolves on ball bearings. Give your grounds unique rural charm! Great centerpiece for planter, flowers. Use to hold yard light, house number, sign or as mailbox. For school, a fine "energy crisis" science project—does everything but pump water. Heavy gauge steel, durable outdoor finish; aluminum color w/red trim. **No. 71,923E (17" DESK MOD.)......$10.95 Ppd.**

4½ foot-14 lb.—No. 71,924E..........$32.50 Ppd.

8 foot-46 lb.—No. 85,229E.............$44.95 FOB

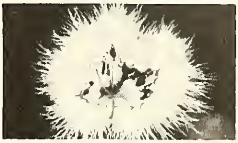
"FISH" WITH A MAGNET

Go treasure hunting on the bottom! Fascinating fun & sometimes profitable! Tie a line to our 3½ lb. Magnet—drop it overboard in bay, river, lake or ocean. Troll it along bottom—your "treasured" haul can be outboard motors, anchors, other metal valuables. 3½ lb. Magnet is war surplus—Alnico V Type—Govt. cost twice our price. Lifts over 40 lbs. on land—much greater weights under water.

Stock No. 70,570E..................(3½ lbs.)......................$11.50 Ppd.

Stock No. 60,215E..................(1½ lbs.)......................$6.50 Ppd.

NEW! KIRLIAN PHOTOGRAPHY KIT!



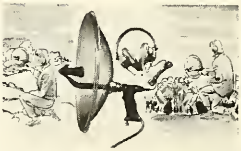
Experiment in the fascinating new field of "Kirlian electrophotography—images obtained on film without camera or lens by direct recording of electric charge transmitted by animate & inanimate objects. Each "aura" differs—animate aura said to change corresponding to physical changes. Kit incls portable darkroom, double transformer isolated from power source; instrs.

Stock No. 71,938..........................$49.95 Ppd.

"HIGH VOLTAGE PHOTOGRAPHY" by H. S. Dakin

No. 9129E...(60-PG. PPBK BK.)....................................$5.00 Ppd.

PRO ELECTRONIC SOUND CATCHER



Parabolic mike w/18¾" reflecting shield & 2 I.C.'s in amplifier magnifies signals 100X that of omni-directional mikes. Catch a songbird ½ mile off; QB's huddle strategy; sounds never before heard. Super directivity gives highest signal to noise ratio poss. Safe: auto. cuts off ear damaging noises. Earphones, tape recorder output, tripod socket. Req. two 9v trans. batt. (not incl).

No. 1649E......(5½ LB.)..$299.00 Ppd.

BIG EAR "TOY" MODEL #80,176E...$26.50 Ppd.

KNOW YOUR ALPHA FROM THETA!

For greater relaxation, concentration, listen to your Alpha-Theta brainwaves. Ultra-sensitive electrode headband slips on/off in seconds—eliminates need for messy creams, etc. Atch'd to amplifier, filters brainwaves, signals beep for ea. Alpha or Theta wave passed. Monitoring button simulates Alpha sound; audio & visual (L.E.D.) feedback. Reliable, easy-to-use unit—comparable to costlier models. Completely safe. Comprehensive instruction booklet.

No. 1635E. (8x3x4"; 24 oz.)..$128.00 Ppd.

LOW COST "STARTER" UNIT

No. 71809E..$49.95 Ppd.

ORDER TODAY! COMPLETE AND MAIL

EDMUND SCIENTIFIC CO.
300 Edscorp Building, Barrington, N.J. 08007

How Many	Stock No.	Description	Price Each	Total

PLEASE SEND ☐ **GIANT FREE CATALOG "E"**

MERCHANDISE TOTAL $

ADD HANDLING CHARGE: $1.00 ON ORDERS UNDER $5.00; 50¢ ON ORDERS OVER $5.00

TOTAL $

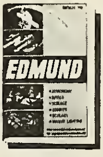
30 DAY MONEY-BACK GUARANTEE
YOU MUST BE SATISFIED OR RETURN ANY PURCHASE IN 30 DAYS FOR FULL REFUND

NAME ______________________

ADDRESS ______________________

CITY ____________ STATE ________ ZIP ________

I enclose ☐ check
☐ money order for $____________



MAIL COUPON FOR GIANT FREE CATALOG!

180 PAGES • MORE THAN 4,500 UNUSUAL BARGAINS

Completely new '74 Catalog. Packed with huge selection of telescopes, microscopes, binoculars, magnets, magnifiers, prisms, photo components, ecology and Unique Lighting items, parts, kits, accesories — many hard-to-get surplus bargains. 100's of charts, illustrations. For hobbyists, experimenters, schools, industry.

EDMUND SCIENTIFIC CO.
300 Edscorp Building, Barrington, N. J. 08007
Please rush Free Giant Catalog "E"

Name ______________________

Address ______________________

City ____________ State ________ Zip ________

South West Africa
EXPEDITION
MERRIMAN & FINNERTY ASSOCIATES

Join us on a trip to one of the world's least visited and most unusual areas — South West Africa, the land of diamonds. • Only 2 inhabitants per square mile, but a rare mix of peoples — Herero, Hottentot, Stone Age Bushman. • The Skeleton Coast, with the remarkable shifting sands of the Namib. • 3 game parks . . . Kalahari Gemsbok, Matusadona Tented Camp, and the world's largest reserve — Etosha. 23 days • Johannesburg, Victoria Falls too • Guest lecturer • $2,283 plus air fare. Send for informative folder.

WINNERS OF ASTA AFRICA TROPHY
Merriman & Finnerty Associates
15 East 48 Street • New York, N.Y. 10017
Name
Address
City
State
Zip

VOYAGE INTO ANTIQUITY
10th Annual Voyage. The most comprehensive Classical Cruise ever offered. Greece, Turkey, Yugoslavia, Sicily, North Africa. October 9 – 29 Days. Brochure – your travel agent or
WORLD TRAVEL ASSOCIATES, INC.
219 Palermo Ave Coral Gables, Fla 33134

BROOKS
BREAK-THROUGH IN CLOSE-UP
PHOTOGRAPHY WITH NOVOFLEX AUTO-DIAPHRAGM & AUTO-BELLOWS SYSTEM. SHOOT FROM 8" TO 30" WITH ELECTRONIC FLASH WITHOUT CHANGING F-STOPS. FOR ADDITIONAL INFO ON "A TOE" WRITE:

NOVO-
FLEX
A
B
C
D
E
F
G

FOR NIKON PENTAX MINOLTA CANON, ETC
BURLEIGH BROOKS OPTICS, INC., • 44 BURLEWS CT., HACKENSACK, N.J. • 201-489-1300

EXCEPTIONAL 5-ACRE RANCH. Lake Conchas, New Mexico. Only $995 per acre. Vacation Paradise. Good long term investment. Easy Terms. Free brochure. Ranchos, Box 2003NH, Alameda, California 94501

100
WORLDWIDE
STAMPS
. . only 10¢

MAGYAR POSTA
RWANDAISE
DUBAI

ACT TODAY. We'll send you this giant offer of 100 exciting postage stamps from romantic Europe, the exotic Orient, angry Africa, everywhere! All genuine, all different our greatest offer yet. Get the scarce Kennedy, Shah of Iran, Space stamps shown PLUS other exciting new, old issues from great empires and tiny republics. Also stamp selections to examine. Buy any or none, return balance. Cancel service anytime. Rush 10c today for your valuable collection.
GARCELON STAMP CO., Dept. 8NHC Calais, Maine 04619

Announcements

At the Planetarium . . .

Classes in astronomy, navigation, and astrophotography, to name a few, will be held during the 1974–75 season at the Planetarium. Courses for adults will be in the evening, and a special Saturday morning series of classes is planned for young people. For a catalog of complete course listings and fees, write to Mary Nettleton at the Planetarium or call (212) 873-1300, extension 206. It's important to register early since enrollment is limited and the classes are quickly filled.

"Signs in the Sky," the current Planetarium Sky Show, casts a scientific eye on the origins of astrology—and comes up with some surprising facts. You can see "Signs in the Sky" through September 16.

Then, beginning on September 17, see "Exploring the Milky Way"—a journey through our galaxy, with its 100 billion stars, nebulae, clusters, and planets.

Sky Shows are at 1:00, 2:00 and 3:30 P.M. during the week, with more frequent showings on weekends. Admission is $1.75 for adults, $.90 for children.

Around the Museum . . .

The Alexander M. White Natural Science Center, newly designed to make city people—especially children—more aware of the presence of the natural world in their environment, is quite a success, judging from the reactions of its first visitors. During the summer, the Center will be open Tuesday–Saturday, 10:30 A.M. to 12:30 P.M. and 1:30 to 4:30 P.M. Admission is free to Museum visitors.

Malaysian Shadow Puppets will be the featured attraction in the auditorium on September 28 at 2:00 P.M. This demonstration by the National Shadow Theatre of Malaysia is open to Museum visitors free of charge.

The 1974 *Natural History* Magazine Color Photography Competition prizewinners and honorable mentions will be exhibited at the Museum beginning September 4. For details about the competition winners, see page 34 of this issue.

Evening Lecture Series . . .

In the series, "Behavior of Animals of the Sea," which begins on Wednesday evening, October 9, seven prominent authorities on marine life will describe the findings of their latest research and discuss its implications for the future. Some topics to be covered:

"Living Clocks of Intertidal Animals" . . . Dr. John D. Palmer, professor of biology at New York University, will talk on how the internal "clocks" of shore-dwelling creatures determine the rhythmic patterns of their movements.

"Love Life and Aquaculture of the Lobster" . . . John T. Hughes, director of the State Lobster Hatchery and Research Station at Martha's Vineyard, will present some of his findings on selective breeding, nutrition, courtship, and mating in American lobsters, as well as their sea farming.

Attendance at these—and the many other evening programs slated for the fall—is by advance registration. Complete catalogs for the Museum's fall lecture series are now available. For your copy, write to the Department of Education here in the Museum or telephone (212) 873-7507.

Field Study Tour . . .

Museum lecturer Christopher J. Schuberth will lead a study tour of the "Field Geology of the Grand Canyon," June 16–29, 1975. The 13-day tour begins with a 10-day, 300-mile float trip down the Colorado River and through the Grand Canyon—from Lees Ferry, Arizona, to Devil's Cove, Nevada—and studies the first 1¾ billion years of Colorado Plateau history. The tour then continues by air-conditioned bus to Zion and Bryce Canyon national parks to study the last 250 million years of Plateau history, and ends at Las Vegas, Nevada. To learn more about this trip, write to the Department of Education or telephone (212) 873-7507.

SMIRNOFF
SILVER®
Pierre Smirnoff
VODKA

THE SILVER MARTINI.
FOR PEOPLE WHO WANT A SILVER LINING WITHOUT THE CLOUD.

SMIRNOFF SILVER. NINETY POINT FOUR PROOF. SMIRNOFF LEAVES YOU BREATHLESS®

SMIRNOFF SILVER® VODKA. 90.4 PROOF. DISTILLED FROM GRAIN. STE. PIERRE SMIRNOFF FLS. (DIV. OF HEUBLEIN, INC.) HARTFORD, CONN.

Minolta helps you share the secrets of waiting.

A dreamlike memory and a wistful expression take on much more meaning when you see them together. You can mix time and place, people and landscapes with a little insight and a camera that doesn't hold you back.

You're comfortable with a Minolta SR-T from the moment you pick it up. That is the 35mm reflex camera that lets you concentrate on mood and insight. All the information you want for focusing and exposure is in the viewfinder. With an easy-to-handle Minolta SR-T, the need to make adjustments never comes between you and your picture.

The SR-T 101 lets you use microprism focusing with a ground glass collar. A scale in the viewfinder shows your shutter speed, from 1 to 1/1000th second, plus bulb.

The SR-T 102 gives you split screen focusing with a microprism collar, and adds an aperture readout to the shutter speed scale in the viewfinder. For multiple exposures, the SR-T 102 is equipped with an override that makes it remarkably easy to obtain any number of image overlays.

All Minolta SR-T cameras give you the patented "CLC" through-the-lens metering system. It protects you from under-exposure by automatically compensating in high-contrast light. Meter-coupled Rokkor lenses stay at maximum aperture, so the finder is always at full brightness until the moment of exposure.

When you see something that needs a different perspective, just snap in one of the complete system of Rokkor lenses, from super-wide 16mm to super-long 1600mm, plus zoom and macro lenses. It takes just seconds, with no ASA or f/stop realignment to waste your time.

Try a Minolta SR-T camera. Share your secrets with the world.

For more information, see your photo dealer or write Minolta Corporation, Consumer Products Division, 200 Park Ave. South, N.Y., N.Y. 10003. In Canada: Anglophoto Ltd., P.Q.

minolta
SR-T 102
minolta
SR-T 101
Minolta

Minolta SR-T 102 / Minolta SR-T 101

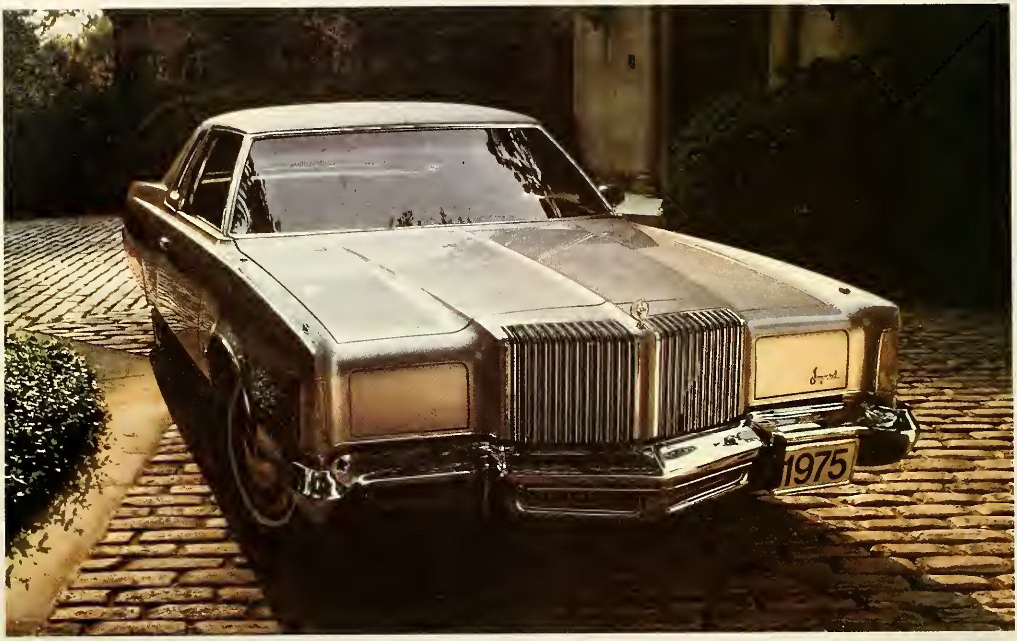
What happens inside your mind can happen inside a camera.

When identified by a factory-sealed "M" tag, Minolta 35mm reflex cameras are warranted by Minolta Corp. against defects in workmanship and materials for two years from date of purchase, excluding user-inflicted damage. The camera will be serviced at no charge provided it is returned within the warranty period, postpaid, securely packaged, including $2.00 for mailing, handling and insurance.

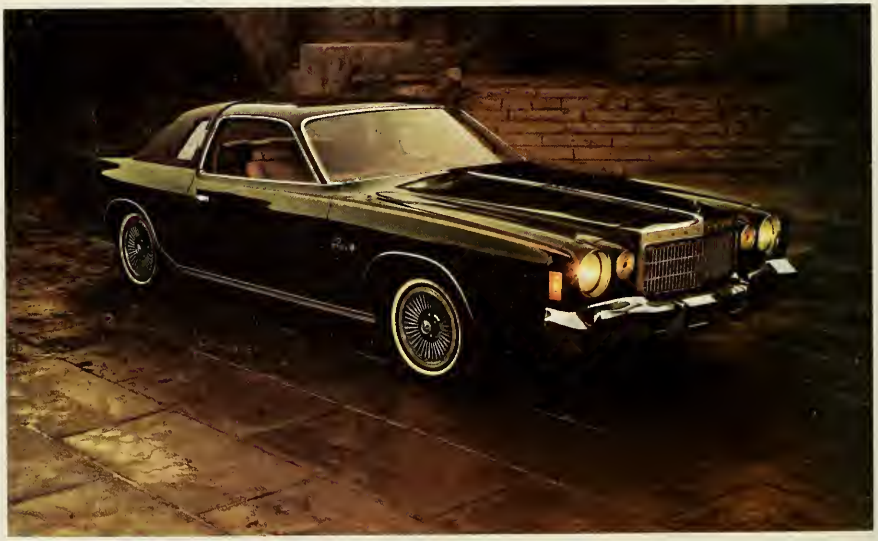
NATURAL HISTORY

OCTOBER 1974 · $1

The Chryslers for 1975.



1975 Chrysler Imperial



1975 Chrysler Cordoba

Excellence in three sizes.

1975 Chrysler New Yorker

Imperial

Imperial LeBaron. The proudest Chrysler. An automobile dedicated to elegance, convenience, comfort and luxury.

There's a strong possibility that LeBaron may be the most comfortable automobile you've ever experienced.

Individually adjustable seats come in warm crushed velour. Available is a version in specially pre-softened leather.

Look into America's other two luxury cars. The 1975 LeBaron is most confident of comparison.

New Yorker

New Yorker Brougham. A Chrysler that continues to set its own distinctive standards in design, luxury, and innovative engineering.

Yesterday it was Electronic Ignition. Today, a new spark plug that can last up to 50,000 miles on unleaded gas.

New Yorker's conveniences leave little to be desired. Its luxury interiors leave even less.

New Yorker Brougham. Still a most beautiful balance between desirability and affordability.

Cordoba. The new small Chrysler.

Designed faithfully in the rich traditions of Chrysler convenience and luxury, Cordoba is at once an automobile of great beauty and harmony.

Seats are available in velour or fine Corinthian leather.

We invite you to experience this new automobile soon at your Chrysler-Plymouth Dealer's. So very luxurious—and yet surprisingly affordable—Cordoba is proudly a Chrysler.

Cordoba. The new *small* Chrysler.

The Chryslers. Imperial. Chrysler. Cordoba.

CHRYSLER
MOTORS CORPORATION

Now's the time to invest in signed originals by Waterford.®

There's no more propitious time for you to invest in Waterford.

Each piece is a signed work of art, made by hand with heart, as it was two hundred years ago.

Even then, it inspired little odes on the part of people who wrote advertisements for Waterford.

Like this one, which appeared in 1790.

The shop is now
completely stored
with choicest glass from
Waterford—
Decanters, Rummers, Drams
and Masons,
Flutes, Hob Nobs, Crofts
and Finger Basons,
Proof Bottles, Goblets, Cans
and Wines,
Punch Juggs, Liqueurs and
Gardevins,
Salts, Mustards, Salads,
Butter Keelers,
And all that's sold by other
dealers.

The spelling has changed somewhat, but not the Waterford. Each piece is still an investment in timeless beauty. You live with it now, yet it grows more valuable with the passing years.

Look for the signature before you buy crystal. Hold Waterford to the light and you can see faintly etched the mark that identifies it as an authentic work of art.

Visit the Waterford Gallery at the important store in your area. Or write for free full-color booklet. Waterford, 225 Fifth Avenue, New York 10010.

Isn't it time you started collecting signed originals by Waterford?

(And English bone china by Aynsley, to go with it.)

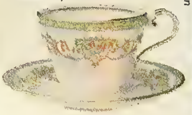


photo: Pesin

NATURAL HISTORY

Incorporating Nature Magazine
Vol. LXXXIII, No. 8
October 1974

The American Museum of Natural History
Gardner D. Stout, President
Thomas D. Nicholson, Director

4 Authors

8 Letters

16 Short-circuiting the Cheap Power Fantasy
George M. Woodwell
Technology is an energy junkie.

22 This View of Life: The Great Dying
Stephen Jay Gould
What prodigious event precipitated the extinction of so many species?

31 A Naturalist at Large: The Flowing Well of Life
Raymond B. Cowles
Man must learn to drink moderately of the heady brew of survival.

36 Beautiful Gamblers of the Biosphere
Edward S. Ayensu
An orchid seed may go a long way to become a lovely flower.

46 Song of the Bunting
William L. Thompson and Kenneth A. Shiovitz
Some birds know they're alike when they sing alike.

52 The Sharecropper's Plague
Daphne A. Roe
Pellagra is alive and well and living among the world's rural poor.

64 Central Park's Fragile Dinosaurs
Adrian J. Desmond
Politics and paleontology can be destructive bedfellows.

72 Special Hunt of the Sharanahua
Text and photographs: Janet Siskind
A man without meat for the table might as well stay in the jungle.

80 Keeping Afloat in a Changing World
A review by Luther P. Gerlach
Shipping-out with the new evangelists of steady state.

90 Sky Reporter: Far-out Comet Watching
Stephen P. Maran

100 A Matter of Taste: One Man's Meat is Another's Person
Raymond Sokolov
If human flesh were disguised, it might be as palatable as mammal brains.

106 Additional Reading

108 Celestial Events
Thomas D. Nicholson

111 Announcements

Cover: *Indigenous to India, the orchid* Bulbophylum (Cirrhopetalum) rothschildianum *is a member of the largest plant family with between 20,000 and 35,000 species. Photograph by Kjell Sandved. Story on page 36.*

Alan Ternes, Editor
Thomas Page, Designer
Board of Editors:
Sally Lindsay, Frederick Hartmann,
Christopher Hallowell, Toni Gerber
Carol Breslin, Book Reviews Editor
Florence G. Edelstein, Copy Chief
Karen Bierstedt, Copy Editor
Angela Soccodato, Art Asst.
Diane Pierson, Editorial Asst.
Lillian Gindea
Rosamond Dana, Publications Editor
Editorial Advisers:
Dean Amadon, Dorothy E. Bliss,
Mark Chartrand, Niles Eldredge,
Vincent Manson, Margaret Mead,
Thomas D. Nicholson, Gerard Piel,
Richard G. Van Gelder

David D. Ryus, Publisher
L. Thomas Kelly, Business Manager
Sue Severn, Production Manager
Ernestine Weindorf, Administrative Asst.
Ann Brown, Circulation Manager
Joyce E. Klutch, Asst.
Joan Mahoney
Harriet Walsh

Harvey Oshinsky, Advertising Manager
Salesmen: Gordon Finley
Harry R. Jeter, Vic Asselin
Eileen O'Keefe, Production
Katrin Magnusson, Asst.

Publication Office: The American Museum of Natural History, Central Park West at 79th Street, New York, N.Y. 10024. Published monthly, October through May; bimonthly June to September. Subscriptions: $8.00 a year. In Canada and all other countries: $10.00 a year. Second-class postage paid at New York, N.Y. and at additional offices. *Copyright © 1974 by The American Museum of Natural History. No part of this periodical may be reproduced without the written consent of* Natural History. *The opinions expressed by authors do not necessarily reflect the policy of The American Museum.* Natural History *incorporating* Nature Magazine *is indexed in* Reader's Guide to Periodical Literature.

Change of address notices, undeliverable copies, orders for subscriptions, and other mail items are to be sent to
Natural History Magazine,
Membership Services, Box 6000,
Des Moines, Iowa 50306.

For people who are still individuals...

the Irish country hat

Each Irish country hat is handcrafted with pride by skilled artisans on the wild, western coast of Ireland. These hats are created by individuals, not production lines, and are designed to become an extension of your own personality.

Shape your Irish hat to suit yourself

The style of your hat can say a lot. That's why the Irish hat leaves the final shape up to you.

The hand-woven tweed is extra thick, and fully lined in the crown. It sheds rain, protects from the wind, and can give you a comfortable shade from the sun.

Irish country hats are made exclusively for Norm Thompson, and come in distinctive gray or brown tweed mixes. Sizes 6¼ to 7⅝. Each $15.00. Two for $29.00.

You have full return privileges.

Norm Thompson Dept. NH-O
1805 N.W. Thurman
Portland, Ore. 97209

Order toll free any time: (800) 547-6712
(Excluding Oregon, Hawaii & Alaska)

Irish Hat(s)	Qty.	Size	Brown	Gray
Men's: 6¼-7⅝				
Women's: 20¼-25				

☐ Check enclosed. ☐ Charge to my BankAmericard. ☐ Master Charge. (Include all raised letters and numbers on card.)

Card No.

Signature X

☐ Send free 80 page color catalog, *"Escape from the ordinary"*

Name

Address

City State Zip

Benedicte Boullet, France

Peter Christian, England

Authors

"I have a continuing interest in establishing a closer relationship between the science of environment and human affairs," says George M. Woodwell, senior ecologist at the Brookhaven National Laboratory and lecturer at Yale University. Trained originally in botany, Woodwell's present work includes a program on terrestrial systems, one on the function of a salt marsh as a unit of the earth's surface, and another on the use of natural and lightly managed terrestrial and aquatic systems to recover the water and nutrients in sewage. Among the publications in which his articles have appeared are *Scientific American* and *BioScience.*

Like the brilliantly colored indigo bunting, zoologist William L. Thompson enjoys vocalizing. He sings with the Rackham Symphony Choir, which performs with the Detroit Symphony Orchestra. Thompson, a professor of biology at Wayne State University in Detroit, specializes in avian vocalizations. He and his wife have transcribed the indigo bunting's song into musical notation. Among his future projects, Thompson plans to make comparative studies of the songs of birds of different species and learn how the avian song vocabulary increases with age.

Kenneth A. Shiovitz was one of Thompson's graduate students. He currently teaches natural science at the Dearborn campus of the University of Michigan. The article on indigo buntings in this issue of *Natural History* is the second that Thompson and Shiovitz have written together.

Chairman of the department of botany at the Smithsonian Institution's National Museum of Natural History, Edward S. Ayensu was born in Ghana. He initially came to the United States as a government scholar to do his undergraduate work. Later he earned a Ph.D. in plant biology from London University in England. He maintains ties with his native country by serving as a visiting professor at the University of Ghana. Orchids, the subject of a book Ayensu is writing, attracted his attention because they are the largest and most highly evolved family of all the flowering plants. Concerned with the relationship between plants and animals, Ayensu has focused particular attention on the impact of bat behavior on the plants of West African savannas.

Shopping for Surprises
with Harry and David
Creators of the Fruit-of-the-Month Club®

BONSAI JUNIPER
Nature in miniature — this little tree is already three years old, yet just 6 inches high. Planted in a special clay pot; comes with 96-page handbook on the ancient and subtle art of Bonsai. Available all year.
Order Gift No. 261 . . . $12.95 delv'd

our famous
ROYAL RIVIERA® PEARS
So big and juicy they'll eat 'em with a spoon — so rare, not 1 person in 1000 has ever tasted them! Beautifully gift packed and sent with your personal greetings. Perfect arrival guaranteed! Net wt. 6-3/4 lbs. Order now for Thanksgiving and Christmas delivery.
Order Gift No. 1 . . . . . $7.95 delv'd

CHRISTMAS CROCUS
Completely pre-planted and ready to grow in a genuine handpainted Delft planter! Nothing to add but water — includes 12 top size bulbs. Do order NOW for Christmas delivery! Available Dec. 10 to Feb. 14.
Order Gift No. 801 . . . . $9.95 delv'd

The Original, One-and-Only
Fruit-of-the-Month Club®

Since 1936, America's favorite family club. Month after month, a parade of the world's rarest and finest fruit sent direct from the orchard. Each gift box with your greetings. All announced by a handsome, gold-embossed Certificate of Membership.

Christmas — Royal Riviera Pears
Jan — Crisp Mountain Apples
Feb — Royal Grapefruit
March — Royal Oranges
April — Hawaiian Pineapples
May — Wild 'n Rare® Preserves
June — Home-Canned Fruits
July — Giant Kiwi Berries
August — Exotic Nectarines
Sept — Oregold® Peaches
Oct — Alphonse LaValle Grapes
Nov — Spanish Melons

3-BOX CLUB Surprise them with gorgeous gift boxes for Christmas, January and February! Gift No. 111 . . . $21.95 delv'd
5-BOX CLUB Keeps coming and coming! Christmas, January, February, May and September. Gift No. 141 . . . $34.95 delv'd
8-BOX CLUB Delight them to pieces again and again! Christmas, January, February, May, August, September, October and November. Gift No. 151 . . . $59.95 delv'd
12-BOX CLUB Flabbergasting! A gorgeous gift every single month of the year. Gift No. 201 . . . $86.95 delv'd

We guarantee your complete satisfaction in every respect . . . or your money back!

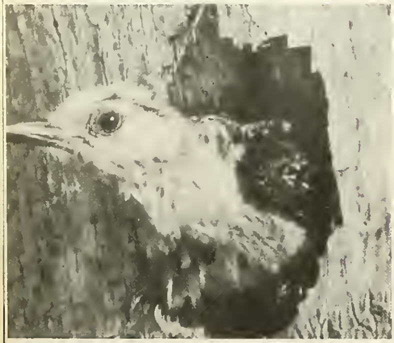
Every year folks write to tell us how pleased their friends are with gifts from Harry and David. Our "secret"? It's the personal touch that's part of every gift we make. Harry and I grow our own fruit, bake our own cakes, put up our own preserves — even make our own baskets. If you could see the care with which our gifts are put together, you'd know why the quality is guaranteed.

EASY TO ORDER Use the order blanks at right, or just send us your list. Enclose check or money order (no C.O.D.'s please). Tell us how to sign your greetings for each gift. All prices include delivery.

Send your orders to:
Harry and David®
Box 553-C Medford, Oregon 97501
©1974, Harry and David

Order here or send us your list
SHIP AS MY GIFT TO ____
STREET ____
CITY ____ STATE ____ ZIP ____
Quantity | Name of Gift | Order No. | Amount $
Ship to Arrive for Christmas ☐ Ship to Arrive On (Date) ____ Use Card I enclose ☐ (Max 3½ x 5)
Greetings to read: ____
SHIP AS MY GIFT TO ____
STREET ____
CITY ____ STATE ____ ZIP ____
Quantity | Name of Gift | Order No | Amount $
Ship to Arrive for Christmas ☐ Ship to Arrive On (Date) ____ Use Card I enclose ☐ (Max 3½ x 5)
Greetings to read: ____
Ordered By ____
Address ____
City ____ State ____ Zip ____
553-C

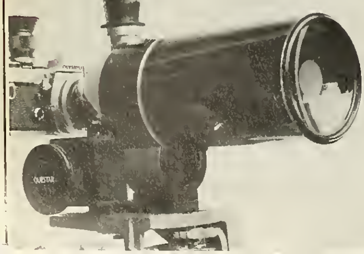
QUESTAR PHOTOGRAPHS THE NEIGHBORS



Fast shots with photo-visual Questar, like this watchful squirrel and rumpled flicker nestling, are easier than ever when you add our Fast Focus to the Field Model. And using this combination with the Questar-modified Olympus OM-1 camera body is a new and exciting experience for the nature photographer.

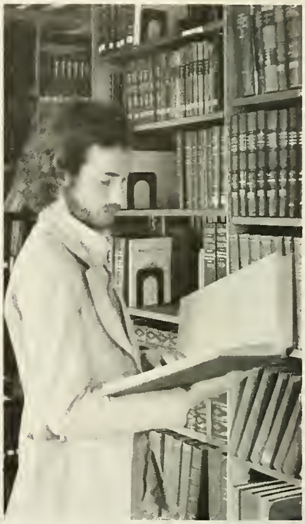
SEND $1 FOR THE QUESTAR BOOKLET WITH ITS 150 PHOTOGRAPHS BY QUESTAR OWNERS. $1 FOR MAILING ON THIS CONTINENT; BY AIR TO S. AMERICA, $2.50; EUROPE AND N. AFRICA, $3; OTHER AREAS, $3.50.

QUESTAR
BOX N 60, NEW HOPE, PA. 18938
©Copyright Questar Corporation 1974



"Some may share with me an attraction to books that are out of date, pictures that are out of fashion, and diseases that no longer ravage the earth," writes Daphne A. Roe. Her study of the social history of pellagra required five years of library research into historical medical documents, as well as visits to sites where pellagra was once endemic. Roe, who is associate professor in the Graduate School of Nutrition, Cornell University, is the author of more than sixty technical papers in the fields of dermatology and nutrition.

Adrian J. Desmond first saw the dinosaur models of London's Crystal Palace Park in 1973, and decided, on the spot, to trace the work of their creator. The search led Desmond to investigate New York City politics in the late 1800s and the fate of Central Park. A student of the history of science at Harvard University, Desmond is currently studying Victorian England's attitudes toward the Darwinian theory of evolution. Desmond has also pursued the paleontology of arthrodires—armored fish that inhabited Scotland some 400 million years ago.



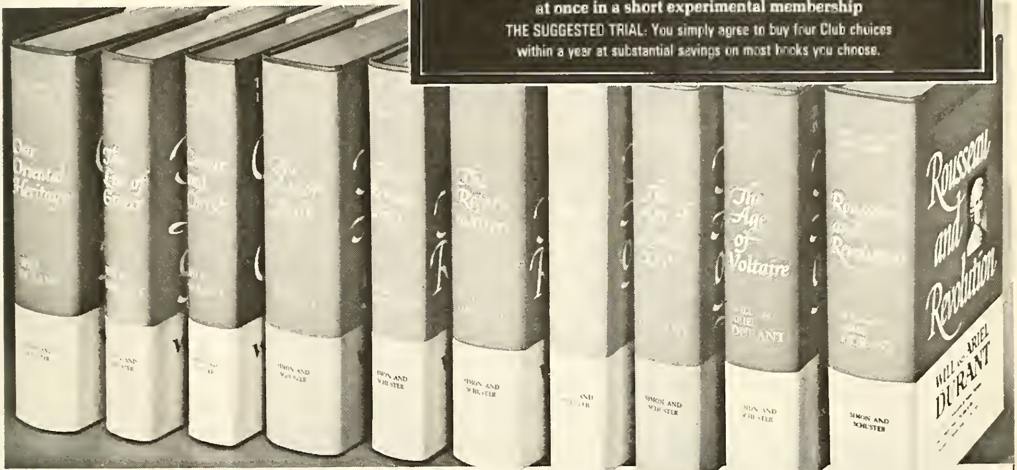
Knowledge of the Sharanahua special hunt was acquired by Janet Siskind during a two-year sojourn in the Peruvian Amazon basin. Beginning in 1966, she observed and conversed with the women who prepared for the hunt, but the men never let her join them on an actual expedition. Their reason: her presence in the jungle would bring bad luck. Siskind originally intended to study Sharanahua folk medicine, but she was sidetracked by the tribal emphasis on hunting, game distribution, and meat consumption, and by how these activities were regulated to maintain the tribal social structure. A professor of anthropology at Rutgers University, her book about the Sharanahua, *To Hunt in the Morning*, was published last year.

As your introduction
to membership in the
BOOK-OF-THE-MONTH CLUB®

THIS GREAT
$150 TEN-VOLUME HISTORY
FOR ONLY $1.50 A VOLUME

at once in a short experimental membership

THE SUGGESTED TRIAL: You simply agree to buy four Club choices within a year at substantial savings on most books you choose.



Complete after forty years' research and writing

The Story of Civilization

by WILL and ARIEL DURANT

I. Our Oriental Heritage. Ancient Egypt and the Near East. The Far East, early to modern times.

II. The Life of Greece. Explores all facets of Greek life from prehistoric times to the Roman conquest.

III. Caesar and Christ. The rise of Rome and Christianity and the collapse of classic civilization.

IV. The Age of Faith. Christian, Islamic and Judaic civilizations, 325 to 1300, including the Crusades.

V. The Renaissance. Italy's golden age, 1304 to 1576. A turbulent world of intrigue and great art.

VI. The Reformation. Europe's religious conflicts, from two centuries before Luther to Calvin.

VII. The Age of Reason Begins. Europe, 1558-1646. The age of Shakespeare, Rembrandt, Galileo.

VIII. The Age of Louis XIV. The brilliant era of the "Sun King," Milton, Cromwell, Peter the Great.

IX. The Age of Voltaire. Europe from 1715 to 1756. The world of Frederick the Great, Wesley, Bach.

X. Rousseau and Revolution. Europe from the Seven Years' War to the storming of the Bastille.

EACH OF THE TEN VOLUMES IN THE SET LISTS FOR $15

THE TRIAL suggested here will prove, *by your own actual experience,* how effectually membership in the Book-of-the-Month Club can **keep you from missing,** through oversight, books you fully intend to read.

As long as you remain a member, you will be sent approximately every three and a half weeks the Book-of-the-Month Club *News,* a literary magazine published by the Club fifteen times a year, which describes the Selection as well as scores of other books, most of which are available at substantial discounts – up to **40%** on more expensive volumes. All these books **are identical to the publishers' editions in content, format, size and quality.** If you wish to purchase the Selection, do nothing and it will be shipped to you automatically. However, there is no obligation to purchase any particular volume. If you do not want the Selection – or you would like one of the Alternates or no book at all – simply indicate your decision on the reply form always enclosed with the *News* and mail it so we receive it by the date specified. If, because of late mail delivery of the *News,* you should receive a Selection without having had 10 days to decide whether you want it, that Selection may be returned at Club expense.

BOOK-DIVIDENDS: If you continue after your trial membership, you will earn at least one Book-Dividend® Credit for every selection or Alternate you buy. These Credits entitle you to obtain a wide variety of books, called Book-Dividends, at astonishing savings—**at least 70% of publishers' list prices.** Under this unique system, more than 100 Book-Dividends will be available to choose from every year, enabling you to acquire a well-rounded library at a small fraction of what you would otherwise have to pay.

INCLUDED WITHOUT CHARGE

A brilliant summary of all the Durants learned during their forty-year study of world history . . . and an invaluable supplement to *The Story of Civilization.*

A copy will be included, *free,* with each set sent to new members who enroll at this time. **Pub price $5.95**

THE
Lessons of History
BY
WILL AND ARIEL
DURANT

BOOK-OF-THE-MONTH CLUB, INC.
280 Park Ave., New York, N.Y. 10017 **4-A398-10**

Please enroll me as a member of the Book-of-the-Month Club and send me *The Story of Civilization* in 10 volumes, billing me $1.50 per volume. I agree to purchase at least four additional Selections or Alternates during the first year I am a member, paying in most cases special members' prices. My membership is cancelable any time after I buy these four books. A shipping charge is added to all shipments.

MR. MRS. MISS ....
(Please print plainly)

Address 35

City ....

State .... *Zip* ....

AMERICA'S MOST POPULAR TELESCOPES

For over 20 years UNITRON Refractors have been the overwhelming choice of the amateur astronomer and school observatory. Exploring the skies with a telescope is a relaxing and educational diversion for the whole family—a hobby which is especially meaningful in the space age. UNITRON offers a complete line of 22 time-proven telescopes as well as many unique accessories to increase observing pleasure. All are available for purchase using our Easy Payment Plan.

A free UNITRON Catalog is yours for the asking.

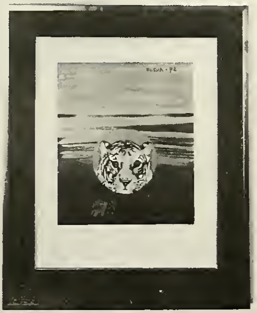
Name________________

Address________________

City________ State________ Zip________

U-21

UNITRON
SCIENTIFIC, INC.
66 NEEDHAM ST., NEWTON HIGHLANDS, MA 02161



TIGER IN THE MOON
A Limited edition lithograph by Fleur Cowles, done especially for The Collection. Each signed and numbered from an edition of two hundred. Print measures 19¾" x 22"; we send them unmatted and unframed (shown framed). #3327A. 150.00.

FROM THE HORCHOW COLLECTION
P. O. Box 34257,
Dept 01653 Dallas, Texas 75234

☐ Please send______Tiger In The Moon lithographs. Check Enclosed. Also enter my subscription to the new Horchow Collection Catalogues

☐ I do not wish to order now but I've enclosed 1.00 for a year's subscription of six issues (including your Christmas catalogue to be mailed in September)

Letters

Artistic Orientation

In "Driftwood Fantasy" [August-September, 1974] Robert Sommer implies that those people who "thought of driftwood as sculpture in itself rather than as material for sculpture" were suffering from the lack of an "esthetic orientation to the environment," while those who saw a seal in a piece of driftwood and enhanced it with flippers and marble eyes had "managed to avoid the atrophy of their esthetic impulses."

If one believes that anything man-made must be an improvement on nature, then perhaps Mr. Sommer is right. But the point is that driftwood, shells, unusual rocks, and pebbles are not, like the lumps of clay he compares them to, mere formless chunks of matter. They are objects that have already been shaped to what they are by winds and waves according to a natural esthetic, and their mysterious and characteristic shapes reveal something of the inward being of nature.

A true esthetic orientation is possible only where nature is respected as valuable and beautiful in itself. The creative impulse grows through loving attention to the natural forms that are the only basis we have for art, rather than from a vulgar impulse to paint lilies or to "improve" pieces of driftwood with flippers.

I do not mean to put down folk art, but I disagree with the assumption that our culture has tended to make: that all nature is nothing more than inanimate raw material waiting to be improved or transformed by man.

Erika Mumford
Cambridge, Massachusetts

Archeological Waste

The unhappy story of the *Tijger*, "Disappearance of the Historic Ship *Tijger*" [August-September, 1974], could be repeated in many communities. Public officials take the pragmatic position that if they stall long enough, the issue will die. Contractors and their crews can hardly be expected to differentiate between significant artifacts and trash, and one can sense between Christopher L. Hallowell's lines what might be termed a "foremen's agreement" not to see anything.

Years ago the city of Schenectady, New York, dug a deep trench for a storm sewer through the center of the Dutch town that had been built around 1661 and burned in 1690. The excavators found a pair of Spanish olive jars and parts of early water mains—one of bored logs fitted together and another of glass pipe encased in cement.

But quite early in the excavation—we learned years later from a workman—they uncovered the stone foundation of the first Dutch church, deep under the present street and exactly where historical documents located it. Although it was a short block from the present church, its historically minded parishioners, and the Historical Society, nobody watched the excavation and nobody photographed or tried to record what was found. (I was just as close, and I failed also.)

Happily, Albany, New York, has been more alert. In recent years the state historic sites officer, Paul Huey, has managed to find and excavate parts of the Fort Orange foundation and to salvage sections of a remarkable water main that brought water from outlying springs into the town a century or more earlier than the log conduit found in Schenectady.

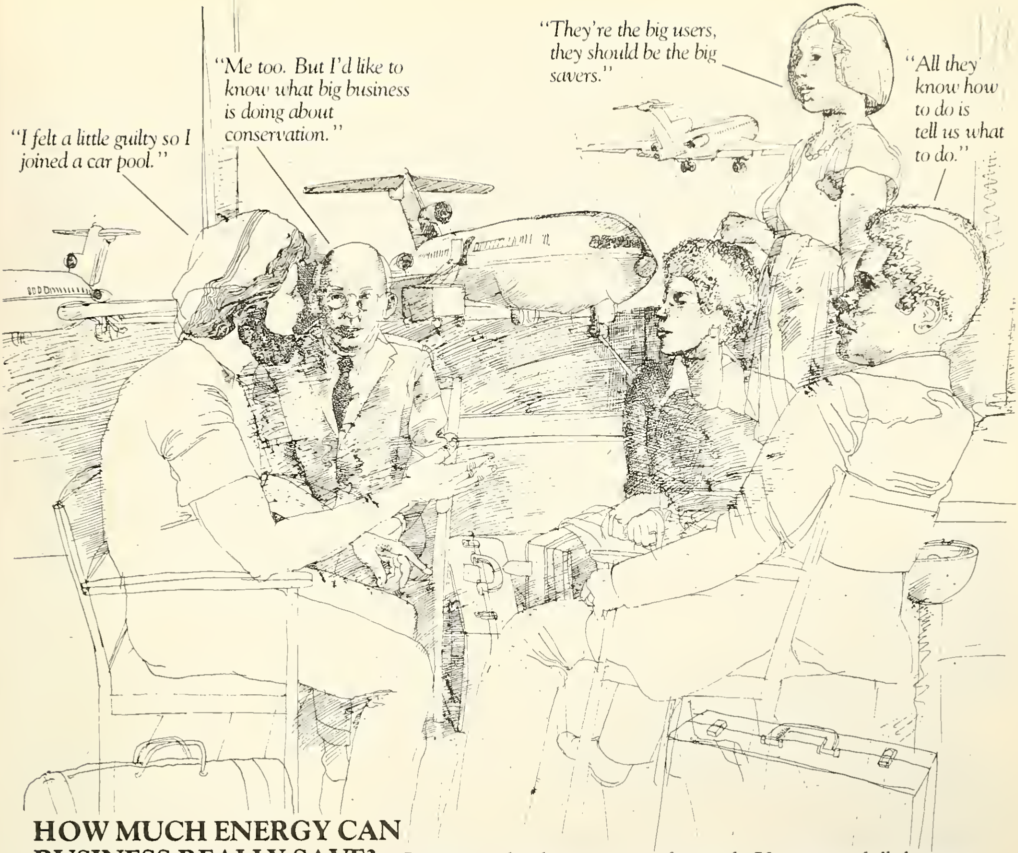
And here in Pittsburgh, excavation for an apartment should have uncovered the remains of the city's first iron furnace. Did it? Nobody knows; nobody cared; nobody had the time (including me).

We need the story of the *Tijger*. Next time maybe someone, somewhere, will remember it and go to see what they are digging up.

P. Schuyler Miller
Pittsburgh, Pennsylvania

Herbicides and Children

Whenever people discuss our expensive defense of South Vietnam, I always feel that the perpetual refugee problem, the neglected, orphaned, and homeless children, the dearth of medical care and public health programs, the omnipresent


"I felt a little guilty so I joined a car pool."
"Me too. But I'd like to know what big business is doing about conservation."
"They're the big users, they should be the big savers."
"All they know how to do is tell us what to do."

HOW MUCH ENERGY CAN BUSINESS REALLY SAVE?

Business and industry account for nearly 70 percent of all the energy used in our country.

With over 12 million businesses operating today, it's no wonder they use all that fuel. If they can be more efficient in their use of energy for commercial, industrial and transportation activities, we could save a huge amount of oil.

For example:

A 15 percent efficiency increase would save the equivalent of about four million barrels of oil a day. That's more oil than we are importing from the Middle East right now–even with the embargo lifted!

Conoco believes that business and industry should shoot for efficiency savings of at least 15 percent in their use of energy. Along with continued conservation of energy by the public, this is the best way we know to help avoid another energy crunch in the next couple of years. And, by holding down energy costs business will be taking an important step in the fight against inflation.

But would conservation also mean a cut in production which might lead to further unemployment?

Conoco thinks not. We know of several large companies that have managed energy savings of over 15 percent per unit of production while they have increased both output and employment. And at Conoco our goal is to improve energy efficiency by at least 15 percent, even as our business and payroll are growing.

Can any business do it?

Yes. Large and small. It's not always easy, but there are no deep secrets to it. Conservation can be as simple as turning out lights or as complicated as developing totally new manufacturing processes. But it *can* be done.

If you're a businessman who wants to know how to start a conservation program, write us and we'll send you three government booklets on energy management: the "Energy Conservation Handbook"; "How to Start an Energy Management Program"; "Economic Sense for Retailers".

Write Conoco, Dept. A 49, GPO Box 29, New York, New York 10001.

Continental Oil Company CONOCO

The most comfortable shoes you've ever worn or your money back!*

The Globetrotter from Norm Thompson... a simple shoe, created solely for comfort.

Here's a great example of what we mean when we say that "less is more"! Globetrotters are made *without* the use of nails or supportive shanks to give you a totally different kind of shoe . . . one we guarantee to be the most comfortable you've ever worn or your money back. There's nothing to bind, constrict or wear through . . . just a single unit, stitched all the way around to roll, bend, and flex with the natural movement of your foot.

You'll feel the difference with your first step. Try 'em yourself for 2 weeks.

Ultra-soft calfskin combines with springy crepe rubber in 119 sizes.

Supple calfskin is carefully shaped over 119 different lasts to insure a near-perfect fit for each of the sizes listed in the chart below. Backs are lined with glove-soft leather, and an absorbent cotton twill in the toes keeps your feet cool and dry.

Soles and heels are fashioned from springy crepe rubber to cushion every step you take and guard against slips. Even if you stand on concrete all day, your feet will feel better and so will you! Between the outer sole and the non-curl leather insole is a layer of finely ground natural cork. It creates a unique foot-forming effect while it insulates against heat, cold, and damp.

Honest good looks.

The Globetrotter has been referred to as a masterpiece of understatement in shoe design. Its handsome styling goes equally well from the office to the ball park because of the clean, uncluttered lines. It represents a skillful blending of the contemporary with the classic for men who stride confidently through life. Black or rich brown **$45.00 ppd.**

"ESCAPE from the ordinary"®

*Globetrotters are made for us by craftsmen at Allen-Edmonds . . . one of America's most respected names in quality footwear. They're so different, we can confidently guarantee them to be the most comfortable shoes you've ever worn.

Try 'em yourself for 2 weeks at home. If you're not completely satisfied, return them to us, postage prepaid, for a full refund . . . no ifs, ands, or buts.

Norm Thompson

Order **TOLL FREE** anytime 800-547-6712
(Excluding Oregon, Hawaii, and Alaska)

Name__________

Address__________

City__________

State__________Zip__________

☐ Check enclosed. Charge to my

☐ BankAmericard. ☐ Master Charge.

(Please include all raised letters and numbers on card)

Card #__________

Signature X__________

Dept. NH-O
1805 N.W. Thurman
Portland, Ore. 97209

No. 2040	Qty.	Size	Width
Black			
Brown			

	6	½	7	½	8	½	9	½	10	½	11	½	12	½	13	14	15	16
AAA							x	x	x	x	x	x	x	x	x	x	x	x
AA							x	x	x	x	x	x	x	x	x	x	x	x
A					x	x	x	x	x	x	x	x	x	x	x	x	x	x
B				x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
C	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
D	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
E	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		
EEE			x	x	x	x	x	x	x	x	x	x	x	x	x	x		

☐ Send **FREE** 80 pg. color catalog. "Escape from the ordinary." Direct import savings on unique items from around the world.

corruption, the diminished arable land and concurrent economic results, and the consequences of the defoliation program are the true results of our prolonged defense. I am happy to see Arthur W. Galston promulgate the facts on defoliation in his article "The Ungreening of South Vietnam" [June-July, 1974].

Most doctors who have spent extended periods of time in South Vietnam think that there are indeed teratogenic effects due to the defoliation. Accurate statistical surveys are difficult, however, because the population is often in a state of flux due to the war, resettlement programs, and the constant creation of refugees and homeless persons.

At the Barsky Unit for Plastic and Reconstructive Surgery in Saigon, children are brought in droves with treatable plastic surgery defects, such as cleft lip and palate, and with nontreatable chromosomal and birth abnormalities. But it is virtually impossible to accurately study cause and effect in such transient populations. One would think that the herbicide-spray records would have to be correlated with the locale of the mother during the first trimester of pregnancy and not the place of birth.

If Congress does decide to help with the terrible ecological and child-related problems created by the war, these problems cannot be solved until the war is over and a relatively stable political climate exists. Dedicated and knowledgeable Vietnamese, who can best solve these problems, cannot work effectively in the present climate of political suspicion and corruption.

PETER D. MAGNUS, M.D.
Pediatric Consultant
CARE-MEDICO
Saigon

Wrong Name

In "Images of a Vibrant World" [August-September, 1974], you captioned a sequence of photographs as "Lions Killing Water Buffalo." They are *not* killing a water buffalo, they are killing a Cape buffalo (*Syncerus caffer*). Water buffalo are not found in Africa except in the United Arab Republic. They are predominately an Asiatic animal, although some have been exported to South America.

JACK R. TISHUE, JR.
Ferndale, Maryland

MAIL POSTPAID CARD TODAY
AND PREVIEW SUPERB NEW

Deutsche Grammophon

recording of the

Four Symphonies of Brahms

months before it becomes available to the general public

Keep All 4 Records For Less Than the Price of One

if you wish, after listening free for ten days as your introduction to

The International Preview Society

DETACH HERE AND MAIL TODAY!

Q52

FOUR-FOR-LESS-THAN-THE-PRICE-OF-ONE PRIVILEGE

THE INTERNATIONAL PREVIEW SOCIETY
175 Community Drive, Great Neck, N.Y. 11025

Please send, for my free preview, the advance edition of Brahms' Four Symphonies by Claudio Abbado. I may return it after ten days and owe nothing, or keep all four records and pay only $6.98 complete, plus small postage/handling charge (and sales tax in New York). This is $24.94 off suggested list price of the regular edition, when it becomes available months from now. I will also receive, at intervals of one or more months, free ten-day previews of albums chosen by the Carnegie Hall Selection Committee, far in advance of general release. I may keep any album for no more, and often for far less, than suggested list price. I am not obligated to buy any minimum number of albums and I may cancel this arrangement at any time.

NAME ______________________
(please print)

ADDRESS ______________________

CITY ____________ STATE ____________ ZIP ____________

Offer limited to the U.S. and its possessions. Offer expires 1/31/75. Limit: One membership per household– Only new members eligible.

19220/Q52

BUSINESS REPLY MAIL
No Postage Stamp Necessary If Mailed In The United States

FIRST CLASS
Permit No.
1955
Great Neck, N.Y.

Postage will be paid by

The International Preview Society
175 Community Drive
Great Neck, New York 11025

DETACH HERE AND MAIL TODAY!

Johannes Brahms
4 SYMPHONIES
Vienna Philharmonic Orchestra
Berlin Philharmonic Orchestra
Dresden State Orchestra
London Symphony Orchestra
CLAUDIO ABBADO

THE Four Symphonies of Brahms

- Brilliantly performed by Claudio Abbado with four of the world's great orchestras.
- Magnificently recorded by Deutsche Grammophon.
- Pressed in Europe to highest quality-control standards.
- Not available for many months except to members.

ALL FOUR RECORDS only $6.98

if you decide to keep them (plus small postage/handling charge).

Now! Preview the great new

Deutsche Grammophon

recording of the complete

FOUR SYMPHONIES OF BRAHMS

superbly conducted by CLAUDIO ABBADO

ALL 4 RECORDS FOR LESS THAN THE PRICE OF ONE

plus free auditions of important new recordings months before they are available to the public!

Johannes Brahms
4 SYMPHONIES
Vienna Philharmonic Orchestra
Berlin Philharmonic Orchestra
Dresden State Orchestra
London Symphony Orchestra
CLAUDIO ABBADO

Try it for ten days FREE.

No obligation to keep it!

Brahms' *Four Symphonies*—most magnificent since Beethoven's! The extraordinary new recording of them from Deutsche Grammophon offers Claudio Abbado conducting *four* of the world's greatest orchestras. This album will not be available to the American public for many months, but you may preview it now for ten days, without charge, without obligation. And you may keep all *four records for less than the price of one*—yes, more than 78% off the suggested list price at which they will eventually be sold in stores!

The Carnegie Hall Selection Committee's report accompanying the album points out why these performances were singled out for their recommendation: freshly conceived, deeply felt interpretations by young Claudio Abbado, Italy's foremost present-day conductor... the unprecedented opportunity for you to enjoy and compare four orchestras unsurpassed in precision, responsiveness and tonal splendor—the Vienna Philharmonic, Berlin Philharmonic, Dresden State Orchestra and London Symphony... plus Deutsche Grammophon's incredibly lifelike sound. The four stereo records themselves are superior, silent-surfaced European pressings, manufactured to highest quality control standards, and come in a handsome hinged case with illustrated brochure and *exclusive* Committee report.

Our preview offer of Brahms' *Four Symphonies* is limited! So please mail card or the coupon on this page today. Listen for ten days. Then either return the album and pay nothing, or keep it for only $6.98 plus small postage/handling charge (and sales tax in New York). This is a savings of *$24.94 off* the suggested retail price when the regular edition is finally released.

How you can be first to enjoy the greatest new recordings!

By replying now, you assure yourself of the privilege of receiving, for future ten-day free previews, special *advance editions* of major new albums...chosen *exclusively* for the International Preview Society by the Carnegie Hall Selection Committee. Since the Society is *not* a record "club", you will never be required to buy any album, nor will you receive a "record-of-the-month" like clockwork. Only when the Committee discovers a new album of the most extraordinary musical interest, artistic excellence and technical quality will it be sent for your free audition, so that there will often be months when no album at all is offered by the International Preview Society.

In every case, you will preview these records *long before* they reach the stores ...with the option of purchasing any album you wish, in a superb imported pressing, including exclusive Committee report... never at a higher price than the ordinary edition will retail for months later, and frequently at *big savings!* You may cancel this arrangement at any time.

If you truly love great music, please mail the coupon today for your exciting Brahms' *Four Symphonies* preview.

All 4 records only

$\$6^{98}$

(plus small postage/handling charge) if you decide to keep them after your free audition!

Fill out and mail this coupon if card is missing

Q52

FOUR-FOR-LESS-THAN-THE-PRICE-OF-ONE PRIVILEGE

THE INTERNATIONAL PREVIEW SOCIETY
175 Community Drive, Great Neck, N.Y. 11025

Please send, for my free audition, the superb recording of Brahms' *Four Symphonies* by Claudio Abbado. I may return it after ten days and owe nothing, or keep all four records and pay only $6.98 complete, plus small postage/handling charge (and sales tax in New York). This is $24.94 *off* suggested list price of the regular edition, when it becomes available months from now. I will also receive, at intervals of one or more months, free ten-day previews of albums chosen by the Carnegie Hall Selection Committee, far in advance of general release. I may keep any album for no more, and often for far less, than suggested list price. *I am not obligated to buy any minimum number of albums and I may cancel this arrangement at any time*

NAME ______________________
(please print)

ADDRESS ______________________

CITY ____________ STATE ____________ ZIP ____________

Offer limited to the U.S. and its possessions. Offer expires 1/31/75 **19219**/Q52
Limit: One membership per household—Only new members eligible

AN UNPRECEDENTED INVITATION FROM THE GOVERNMENTS OF INDONESIA,

"If you help us save our we will make available one investment opportunities in

Collectors who are familiar with the spectacular rise in values enjoyed by gold and silver proof coins in recent years will not want to miss out on this opportunity to acquire these limited-edition, legal tender proof coins in 92.5% silver and 90% gold struck at the Royal Mint of Great Britain under truly historic circumstances.

Here is an unprecedented opportunity for you to perform a magnificent act of compassion in support of the world's endangered wildlife and, at the same time, make an investment that may dramatically increase in value.

To make this possible, 24 concerned nations have joined to issue three legal tender coins each to uniform specifications. The reverse sides of the coins feature endangered wild animals. Limited quantities of the proof coins are being released for sale throughout the world to help finance critically needed conservation projects.

The *investment* aspects of this program are especially impressive:

1. *These are legal tender currency.* As such, they are not to be confused with commemorative "medallions" and pseudo coins. In the past, legal tender proof coins have increased in value by as much as 225% in a single year. In fact, since 1950, the coin market has averaged a yearly gain of 25%!

2. *These coins are struck in severely limited editions.* Only 30,000 of each silver coin and 3,000 of each gold coin are being issued in proof condition throughout the world. Once the original issue is sold, future collectors will have no choice but to obtain these coins from the original buyers, such as yourself. After the last proof coin is struck, dies will be destroyed in the presence of an official of the issuing nation.

3. *These are proof coins,* designed and struck to the highest possible quality. They are stamped from special high-quality polished dies. Their raised relief is frosted on a mirror-like background. They are micro-examined for flaws and are never touched by bare hands. This is the procedure followed by the Royal Mint to make presentation pieces for the coronations.

4. *These coins are issued only in silver and gold,* precious metals with high intrinsic values that have risen steadily in recent years. Although U.S. citizens may not now purchase gold coins of recent mintage, this law will be changed by January 1, 1975, and we are, therefore, accepting applications at this time.

5. *These coins are created under truly history-making circumstances.* Never before have proof coins of this quality, in such limited quantities and to uniform specifications, been issued in an international collection. The pleasure and pride of owning such coins cannot help but to increase the demand for them.

How the coins are issued

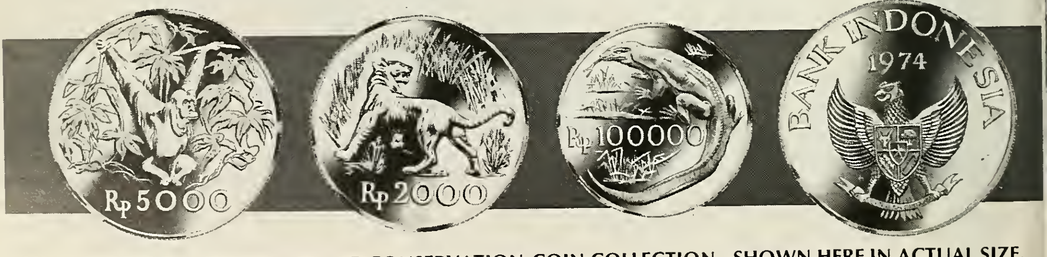
Each of the 24 participating nations will issue three denominations of coins—a 42mm diameter silver coin, a 38.61mm smaller silver coin of different design, and a 34mm gold coin, also with its own design. One side of each coin will depict a species endangered in that country. The other side will be the country's standard design.

Every two months the coins of another nation will be offered to collectors. The complete set of mintings by the 24 nations will be completed in four years. Subscriptions are accepted in advance for a period of one year (six issues). As a subscriber you will be protected against price increases during the year. After that, you may subscribe for the second, third or fourth year as you wish.

Your coins will be shipped to you direct from Spink & Son, Ltd., in London. In addition, yearly subscribers to the silver proof series or either the proof or uncirculated gold series receive, at no additional charge, a handsome display chest as a lifetime repository for your coins.

Apply now to assure your collection

The initial response of collectors to the Conservation Coin Collection in Europe and North America gives every indication that these magnificent coins will quickly be oversubscribed. All applications received after the coins are fully subscribed will be returned with the remittance enclosed. We earnestly recommend that you act promptly. Even if you change your mind later, you are protected by the refund privilege contained in the application form. Please mail it today.



FROM INDONESIA—THE FIRST IN THE CONSERVATION COIN COLLECTION—SHOWN HERE IN ACTUAL SIZE.

42mm diameter silver proof
Weight: 35 grams
Edge Thickness: 2.87mm
Fineness: 92.5% of pure silver
Silver Content: 499.6 grains
Face Value: 5,000 Rupiah
Depicts the Orang-Utan

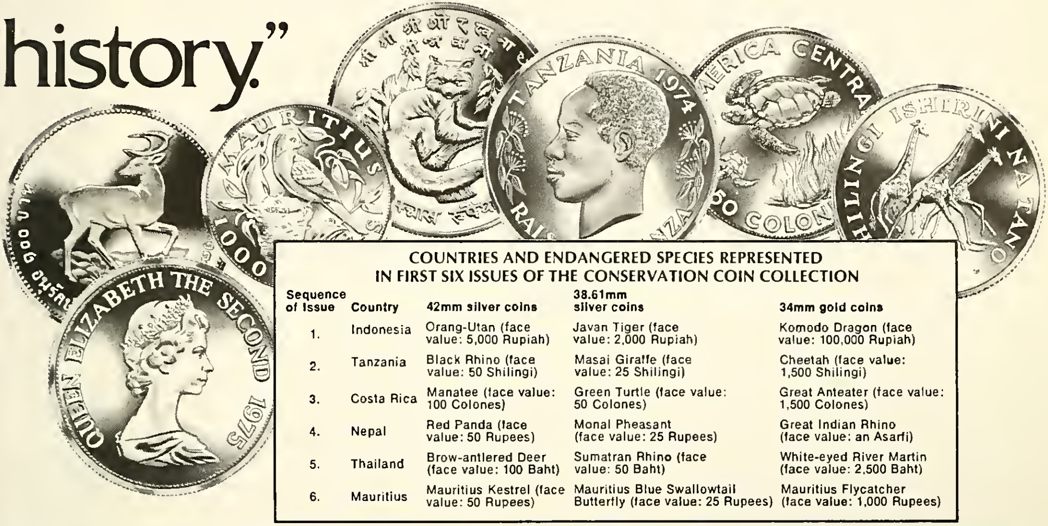
38.61mm diameter silver proof
Weight: 28.28 grams
Edge Thickness: 2.75mm
Fineness: 92.5% of pure silver
Silver Content: 403.6 grains
Face Value: 2,000 Rupiah
Depicts the Javan Tiger

34mm diameter gold proof
Weight: 33.437 grams
Edge Thickness: 2.49mm
Fineness: 90% of pure gold
Gold Content: 464.41 grains
Face Value: 100,000 Rupiah
Depicts the Komodo Dragon

While one side of each coin of a country will have a different reverse design representing an endangered species, the other side of all coins will show the traditional design struck on coins of that country.

TANZANIA, COSTA RICA, NEPAL, THAILAND, MAURITIUS AND 18 OTHERS:

endangered wildlife, of the most remarkable history.”



COUNTRIES AND ENDANGERED SPECIES REPRESENTED IN FIRST SIX ISSUES OF THE CONSERVATION COIN COLLECTION

Sequence of Issue	Country	42mm silver coins	38.61mm silver coins	34mm gold coins
1.	Indonesia	Orang-Utan (face value: 5,000 Rupiah)	Javan Tiger (face value: 2,000 Rupiah)	Komodo Dragon (face value: 100,000 Rupiah)
2.	Tanzania	Black Rhino (face value: 50 Shilingi)	Masai Giraffe (face value: 25 Shilingi)	Cheetah (face value: 1,500 Shilingi)
3.	Costa Rica	Manatee (face value: 100 Colones)	Green Turtle (face value: 50 Colones)	Great Anteater (face value: 1,500 Colones)
4.	Nepal	Red Panda (face value: 50 Rupees)	Monal Pheasant (face value: 25 Rupees)	Great Indian Rhino (face value: an Asarfi)
5.	Thailand	Brow-antlered Deer (face value: 100 Baht)	Sumatran Rhino (face value: 50 Baht)	White-eyed River Martin (face value: 2,500 Baht)
6.	Mauritius	Mauritius Kestrel (face value: 50 Rupees)	Mauritius Blue Swallowtail Butterfly (face value: 25 Rupees)	Mauritius Flycatcher (face value: 1,000 Rupees)

A FEW RECENT EXAMPLES OF LIMITED-EDITION PROOF COIN APPRECIATION

COIN	Issue Yr.	Original Selling Price	Current Selling Price	% of increase reflected in current price vs. original selling price
Western Samoa $1 proof coin	1973	$16.80	$ 84.00	400%
Israel 10 Pound proof coin	1971	$16.80	$ 72.00	329%
Germany 4-coin Olympic proof set	1972	$21.60	$ 52.80	145%
New Zealand 5-coin proof set	1972	$18.00	$ 36.00	100%
Mauritius 200 rupee gold proof	1971	$42.00	$132.00	214%

NON-PROOF UNCIRCULATED COINS AVAILABLE . . .

All coins will also be available in uncirculated editions struck to the same standard as circulated coins, but with much less mechanical handling. They are the best possible example of a country's coinage and considerably more valuable than circulating coins.

IN SILVER...Uncirculated silver coins are composed of 50% of pure silver and are being minted in unlimited quantities. They are offered by one-year subscriptions to both the 42mm and 38.61mm series—sent to you in pairs every two months. **Limit: two yearly subscriptions per customer.**

IN GOLD...Uncirculated gold coins, composed of the same gold content (90% or 464.41 grains) as the gold proof coins, are being minted in a limited edition of 10,000. Applications are being accepted for the first six issues of these coins. **Limit: two yearly subscriptions per customer.**

Royal Mint of Great Britain is the official mint of the United Kingdom and is responsible for the series. All designs for coins to be minted at the Royal Mint, including the designs for the Conservation Coin Collection are reviewed by the Royal Mint Advisory Committee, under the Presidency of His Royal Highness the Duke of Edinburgh.

Spink & Son, Ltd. was founded in 1666 and is managing agent and numismatic advisor to the issuing governments. Spink is the world's oldest and a highly respected dealer in coins and fine arts . . . and, by Royal appointment, medallists to Her Majesty Queen Elizabeth II and His Royal Highness the Duke of Edinburgh.

World Wildlife Fund is an international foundation devoted to conserving nature in all its forms. Since its founding in 1961, the **WWF** has provided financial aid for over 1000 conservation projects in 84 countries, including the U.S. Its president is H.R.H., the Prince of the Netherlands.

International Union for the Conservation of Nature and Natural Resources—sister group to the WWF—is the world's leading scientific conservation organization. The U.S. government and 56 U.S. conservation agencies are affiliated with the Union.

APPLICATIONS MUST BE POSTMARKED NO LATER THAN NOVEMBER 15, 1974

Conservation Coin Collection

003064

250 Hudson Street, New York, N.Y. 10013

Applications for the first six countries' issues of the Conservation Coin Collection are now being accepted. All six issues will be completed by August, 1975. The first coins—from Indonesia—are ready for immediate delivery and will be followed by Tanzania, Costa Rica, Nepal, Thailand and Mauritius, issued at two-month intervals starting October, 1974.

REFUND PRIVILEGE: If, for any reason, you are not satisfied with any of the coins (proof or uncirculated) purchased in response to this offer, you may return them, in their original condition, within 90 days of receipt to Spink & Son, Ltd. for either exchange or a full refund.

SILVER COINS

Please accept my application for the coins I have indicated below from Indonesia. I understand that you will reserve for me the same coins from Tanzania, Costa Rica, Nepal, Thailand, and Mauritius. I enclose payment for the Indonesian coins and agree to pay for each of the subsequent issues in advance of shipment.

Quantity		Amount Payable with Application
______ Limit 1	38.61mm and 42mm silver **proof** set at $50 per set	$______ E1
______ Limit 2	38.61mm and 42mm silver **uncirculated** set(s) at $32.50 per set	$______ G1
	Add $2.50 to cover processing, registered mail, postage and insurance for the first issue	$2.50
	Total amount payable now for first issue	$______

Make checks or money orders payable to Conservation Coin Collection.

GOLD COINS

Please accept my application for the coins I have indicated below from Indonesia. When legislation allowing U.S. citizens to own freshly minted gold coins becomes effective (January 1, 1975, or sooner), and if my application is accepted, you will reserve for me the same coins from Tanzania, Costa Rica, Nepal, Thailand and Mauritius. You may bill me for the same gold coins of any issue which may have been struck prior to that date. I agree to pay for each of the subsequent issues in advance of shipment. This application is made without obligation to myself or Spink.

Quantity		Amount to be Billed per Issue
______ Limit 1	34mm gold **proof** coin at $720 per coin	$______ A1
______ Limit 2	34mm gold **uncirculated** coin(s) at $300 per coin	$______ B1
	Add $2.50 to cover processing, registered mail, postage and insurance per issue	$2.50
	Total amount to be billed per issue	$______

Name______________________________
(Please Print)

Address____________________________

City______________State______________Zip______________

Short-circuiting the Cheap Power Fantasy

The price of increased energy consumption is a reduction in the earth's carrying capacity for all life

by George M. Woodwell

Energy drives our world. Energy from oil is sending me eastward at 600 miles per hour in a giant airplane flying 30,000 feet over the Wyoming desert. Energy from oil was used to smelt the aluminum to build the plane; more energy from oil was used to make the plastic tray I'm writing on, the plastic fiber of the seats; still more to freeze the ice in my lemonade, served in a plastic cup. Most of my world is fossil fueled—but not quite all.

A hitchhiking fly tickles my hand. I flick it away. It moves to the window, attracted by the sunlight reflected from the plane's wings. The fly's source of energy is, of course, the sun. This solar energy flows to the insect through green plants somewhere far away. And the energy I use in flicking my hand also comes from the sun, fixed in photosynthesis somewhere recently, perhaps in the great green circles of western Nebraska's irrigated farmland now passing below me. Outside my silver capsule, the sun dominates: warming the land, evaporating water, heating the air, circulating the oceans, making the weather, causing the winds—and providing the energy for all life.

These are the two sources of energy used by man. The first, principally fossil fuels—but also including water power, nuclear power, and geothermal power, among other minor sources—drives our technology. The other source, the sun, drives the biosphere. A small fraction of the total energy from the sun, perhaps 0.1 percent of all the solar energy reaching the top of the atmosphere, is fixed in photosynthesis and becomes available to support life. Most of the balance is reflected immediately back into space. Both sources—energy in the technological segment and energy from biotic resources—are currently in short supply, locally and around the world. In addition, shortages of fossil fuels have profound implications for all biotic resources, including food.

The immediate problem is a decline in the rate of increase in oil production in the United States. Total production appears to have reached a peak just when worldwide demand is soaring. The decline in resources means that the United States no longer holds a dominant role in bargaining for oil elsewhere. As a result of this squeeze, prices are rising and gross changes are occurring in the relative costs of different sources of energy. What are the implications of these changes for biotic resources?

We should base our answer on a consideration of the size of these two energy flows, one through technology and one through life. Two recent studies are of help. The "Energy Policy Project," financed by the Ford Foundation, issued a preliminary report not long ago that summarized the various uses of nonbiotic energy. According to the report, the total energy use in 1973 from all nonbiotic sources, including fossil fuels, hydropower, geothermal sources, and nuclear power was about 66 trillion (66×10^{12}) kilowatt-hours. The United States consumed about one-third of this. Use has been increasing rapidly in recent years. It now takes about twelve years for total energy use to double; the U.S. doubling time has recently been estimated at about eighteen years.

The second study, by R.H. Whittaker and G.E. Likens of Cornell University, is a comprehensive appraisal of the total amount of energy fixed on earth by green plants. That total is thought to be equivalent to about 840 trillion kilowatt-hours per year. This is net primary production, the energy available to support animals, including man, and the organisms of decay. About two-thirds of this total is fixed in terrestrial ecosystems, mostly forests. Agriculture supplies about one-twentieth of the total. Contrary to popular belief, agriculture is not a cornucopia of new resources in support of man; it is simpy a diversion of net primary production from one form and place to another. The diversion is made by lavish use of energy in technology. Recent estimates suggest that several units of fossil fuel energy are required to produce each unit of food energy. This ratio demonstrates the importance of society's energy flows in maintaining modern agriculture.

The energy available worldwide as net primary production was probably ten to fifteen times the amount of energy used in the technological segment of society in 1973. How much of this solar energy is used to sustain human life? Direct use includes all of the energy fixed in agriculture for food production. Cultivated land supplies net primary production approximately equivalent to 40 or 50 trillion kilowatt-hours annually. We must add to that estimate the harvests of food from natural systems, including the harvests of grazing mammals. The magnitude of this entire segment might be as much again as the flow to man from cultivated land.

We also harvest fish from the oceans. The total yield of fish is about 70 million tons annually; it has not increased in recent years despite intensified efforts in fishing. While better management of fisheries might increase the yield somewhat, at present, fish are probably being harvested at about the maximum rate possible.

In addition to these uses of food, we harvest large quantities of lumber for fuel, pulp, and construction purposes from natural or lightly managed plant communities around the world. The total current harvest of forests probably exceeds the annual growth, since massive inroads are being made in this decade on old-growth forests. Such a drain on natural ecosystems cannot be sus-

PIONEER STEREO RECEIVER model SX-535
STEREO
FM
AM
PHONES
POWER
OFF ON
SPEAKERS A B
BASS
MIN
TREBLE
MIN
BALANCE
LEFT
MONO
TAPE MONITOR 1 2
LOUDNESS
VOLUME
MIN
FUNCTION

The best keeps getting better.

The predecessor to this Pioneer AM-FM stereo receiver established a tradition of value in its class. And we've made the completely new and more powerful SX-535 even better.

The SX-535 has the quality workmanship, precision engineering and design excellence that are so important to the concept of real high fidelity. And it comes to you from the manufacturer of the finest stereo receivers in the world — Pioneer.

Look at the features. A phase lock loop stereo multiplex circuit for improved, stable stereo separation and lower distortion. Two big, easy-to-read meters — one for signal strength and one for center-of-channel tuning. There's also selectable FM interstation muting circuitry and loudness control. Click-stop bass and treble tone controls. Stereo/mono switch. The SX-535 also has provisions for two tape decks and tape-to-tape duplication, plus front panel microphone and headphone jacks. It has connections for two pairs of speakers, selectable from the front panel.

Look at the specifications. 20 watts per channel minimum continuous power, 40Hz — 20kHz, with maximum total harmonic distortion 0.8% at 8 ohms. That's real power to give you smooth response and crisp, clean, perfect sound. The FM sensitivity is an exceptional 1.9uV. And the capture ratio is an extraordinary 1.0dB.

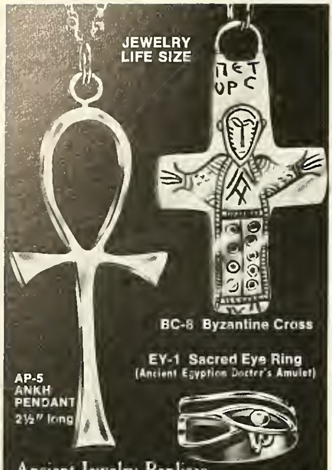
Look at the price. $299.95, including the walnut cabinet. Look again at the price. Only $299.95. Fantastic!

If you want a little more power, the new Pioneer SX-636 offers 25 watts per channel minimum continuous power, 20Hz — 20kHz, with maximum total harmonic distortion 0.5% at 8 ohms. And it's only $349.95, including the walnut cabinet.

Making the "best" better is never easy. But Pioneer believes the extra time and effort it takes are well worth it. When you hear the SX-535 you're bound to agree.

U.S. Pioneer Electronics Corp., 75 Oxford Drive, Moonachie, New Jersey 07074
West: 13300 S. Estrella, Los Angeles 90248 / Midwest: 1500 Greenleaf, Elk Grove Village, Ill. 60007 / Canada: S.H. Parker Co.

PIONEER®
when you want something better


JEWELRY LIFE SIZE
BC-8 Byzantine Cross
EY-1 Sacred Eye Ring (Ancient Egyptian Doctor's Amulet)
AP-5 ANKH PENDANT 2½" long

Ancient Jewelry Replicas
In 14 Karat Gold & Sterling Silver

		Sterling Silver	14K. Gold
AP-5	Ankh Pendant 24" ch.	$32.50	$119.50
BC-8	Byzantine Cr. 24" ch.	35.00	125.00
EY-1	Sacred Eye Ring	29.50	119.50

Rings sized to 11½ no extra cost. • Money back guarantee. Add $1.50 for insured postage. • Orders shipped promptly. • Bankamericard & M.C. for orders $50. minimum.

COLLECTOR'S CATALOG . . . picturing relics from ancient worlds—BC to AD. Plus special Jewelry Catalog showing ancient replicas in precious metals. Both catalogs—50¢ . . . Free With Order!

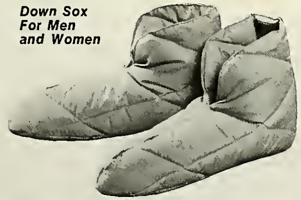
VISIT GALLERY—APPT. ONLY—CALL CI 6 0793

aladdin house, ltd.
Dept. NJ1074 • 648 Ninth Ave. • N.Y. 10036

SOLID 24K. GOLD JEWELRY AVAILABLE—PRICE ON REQUEST

Cloud-Soft Travelers

Down Sox For Men and Women



Slip on a pair of these to keep your feet warm in sleeping bag or bed; as inner sox for insulated pacs or waders. Downright comfortable travel slippers. Bauer Goose Down quilted in tough, washable Nylon taffeta. **Colors:** Red, Winter Blue, Taupe, Powder Blue. Specify shoe size. Men's 4-13, Women's 5-13 and we will send a proper fit. 0123 Goose Down Sox, pair $8.95 postpaid.

Order Today! Money Back Guarantee!
Enclosed is my check or money order for
$______. (Add sales tax where applicable.)
Please RUSH my 0123 Goose Down Sox.
Men's Size______Color______
Women's Size______Color______
Name______
Address______
City______
State______Zip______
☐ Send me FREE your new color catalog of over 1000 exciting outdoor products.

Eddie Bauer®
Dept. ONH, 1737 Airport Way S., Seattle, Wa. 98124

tained, of course. A conservative estimate suggests that as much as 30 to 50 percent of the net primary production of the earth is being diverted to direct use by man for support of the current population.

This estimate of the use of the biota does not take into consideration what I call the "public service functions of nature." These include the stabilization of water flows through river valleys, the purification of air and water, the amelioration of local climate, the control of plant and animal populations, the stabilization of soils, and the retention of nutrients in biotic cycles. These functions are commonly assumed to continue no matter how intensively biotic resources are exploited, but there is powerful evidence that these services performed by nature are now being lost.

The losses are due to two types of biotic changes. First, there has been an unprecedented decrease in numbers of species. We are living in a period in which the numbers of different plants and animals are being reduced more rapidly than at any other time in the history of the earth. Second, the losses of species are coincident with a systematic reduction in the structure of natural ecosystems around the world, especially in forests. Clear-cutting of old-growth stands reduces not only the standing crop of trees but may also reduce the capacity of the site for photosynthesis. Losses of nutrients, changes in the physical conditions of soils, erosion, and other changes in the site frequently reduce its capacity for supporting vegetation of any type. The spread of an impoverished Sahara southward in Africa, the reduction of tropical rain forests and their replacement with scrub, and the destruction of large areas of temperate-zone forests all reduce the capacity of the earth for sustaining human life, the arguments of exploiters notwithstanding.

The net effect of these changes is the gradual, cumulative, and largely irreversible biotic impoverishment of the earth. The extinction of species is an irreversible change. The loss of nutrients normally held in the biota of the uplands is irreversible in a time span that is of interest to us. The destruction of natural communities in lakes, streams, and coastal oceans by eutrophication and pollution, and the heedless redistribution of species by man also constitute irreversible change. In the Great Lakes, for example, the combined effects of human actions in changing drainage basins, modifying patterns of water flow, causing pollution, and carelessly introducing alien fish has grossly impaired the ability of the lakes to supply food and other services for man. The question is, how do we recognize the small steps that lead to such major changes?

The structure and function of natural communities follow clear and well-known patterns of change. The patterns of biotic impoverishment have been known in many cases for hundreds, even thousands, of years. One of the best modern examples is an experiment at Brookhaven National Laboratory, where for more than a decade the effects of ionizing radiation on a forest have been examined. A large source of ionizing radiation was set up in the center of a uniform stand of oak-pine forest. The radiation source was 9,500 curies of cesium 137, a radioactive by-product of the atomic energy industry that emits gamma radiation similar to X-rays. The source was large enough to provide a gradient of radiation intensity ranging from several thousand roentgens per day within a few yards of the point of emission to about 1 roentgen per day at 400 feet. The experiment was started in November, 1961, and has continued to the present.

Within six months of the start of irradiation, the pattern of damage to the vegetation had been established. There were five clear zones of effect. In a zone close to the radiation source, no higher plants survived. At slightly lower radiation exposures only certain hardy herbaceous plants of the forest floor survived, principally the sedge *Carex pensylvanica.* At lower exposures, the carex was joined by the shrubs of the forest: blueberries and huckleberries. At still lower exposures, about 160 feet from the source, certain trees survived, forming an impoverished oak forest zone. At exposures below a few roentgens per day, all of the higher plants of the forest survived, including the indigenous pine *Pinus rigida.* The pine, which is the most sensitive to ionizing radiation, was removed by very low exposures, leaving a forest that appeared otherwise intact.

This form of biotic change is not unusual. While the cause of the change in the Brookhaven experiment was an extraordinary exposure to ionizing radiation, parallel changes also take place where no such experiment has been conducted. A pattern of systematic change of structure occurs in forests exposed to wind, salt spray, and extremes of pollution. Similar changes in vegetation occur additionally around smelters that emit oxides of sulfur and heavy metals into the atmosphere. As human influences spread around the world, we find various stages of ecological impoverishment characteristic of regions that have long been inhabited by man. The vegetation of the Mediterranean region and the Levant are impoverished forests, reduced by the effects of human habitation over thousands of years.

The common assumption is that industrial energy has freed man from dependence on biotic resources. Nothing could be further from the truth. The real effect of industrial flows of energy has been to allow the transformation of net production from less useful to more useful forms. The transformations are maintained, in turn, only at considerable effort and expense. The replacement of forests by agricultural communities of various types is one such transformation. The use of energy in technology also allows the transport of net primary production around the world to convenient places for man.

But there are limits. In the fifteen years between 1951 and 1966, a 34 percent increase in food production was accompanied by a 146 percent increase in the use of nitrates and a 300 percent increase in the use of pesticides. There is every reason to believe that the further intensification of agriculture will require similarly disproportionate efforts as less fertile lands are put into production. Moreover, there is reason to fear that toxification of the environment over large areas will aggravate this problem. As food becomes more and more expensive, driven up in price by scarcities born of increasing population, the pressures on agriculture can be expected to increase. Because ever larger amounts of nitrates and pesticides are required to produce an improved agricultural yield, the in-

Nikon wants you to see better

Nikon prism binoculars start with world-famous Nikon optics, made from Nikon optical glass. Lenses and prisms for right and left barrels are precisely matched and collimated, and the optical parallelism of both barrels is verified.

That's why with Nikon binoculars you enjoy brilliant, sharp, full-field viewing without strain or fatigue, even for long stretches. Now, find out how little more it costs to see better, longer. At Nikon camera dealers and selected optical departments. Write for literature Folio 18, Nikon Inc., Garden City, N.Y. 11530. Subsidiary/Ehrenreich Photo-Optical Industries, Inc. EPOI
(In Canada: Anglophoto Ltd., P.Q.)

Nikon Binoculars

Tables by Davis

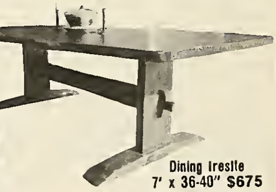
"From timber-to-tables"

Featuring **American Black Walnut**
(Juglans Nigra)
The Aristocrat of Wood
(Native only to America)

In our showroom you can find rich grained tables of many styles and a large selection of table tops awaiting leg-fabrication. These 2" thick pieces of varied widths and lengths are the result of years of selective searching for "Great Walnut Trees," past their prime, overaged and stagging out. These trees are ready for harvest—then crafted "to live again" in nature's own design.

We make coffee, dining, end and conference tables—bars, benches, wall plaques. Deep wildlife handcarving on table corners by order. All pieces are kiln dried and have a hand rubbed Danish Oil Finish. Prices based on size, shape and grain. Call for appointment—let us help you create your Table. Brochure on request.

Dining table
7' x 40"
$675



Dining trestle
7' x 36-40" $675
Free Form or Formal

36" Disc glass top.
$275

Crotched coffee table
4'x 17" $175.00

TABLES BY DAVIS
84 Forest Road Milford, Conn. 06460
Phone 203-874-7184 or 874-1861 (Conn. Turnpike Exit 39)

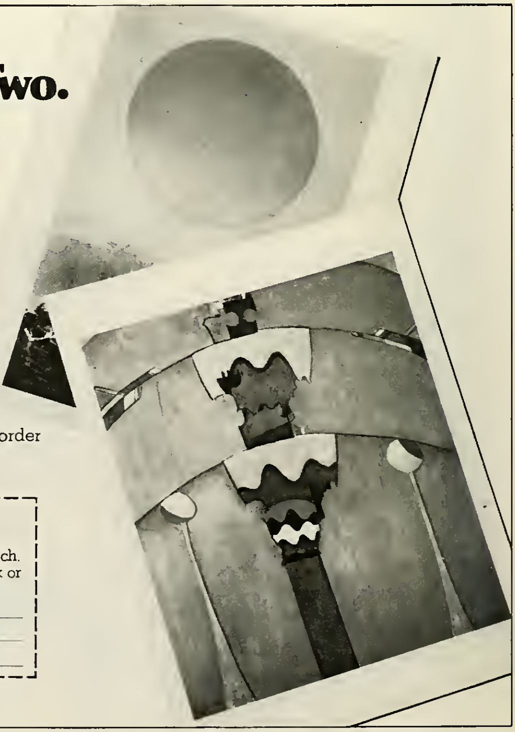
tensification of agriculture will require additional energy. This energy will be applied less efficiently in the future than at present. Just as we appear to have reached the limits of oceanic fisheries so, in many instances, we may also have reached the limits of terrestrial agriculture, unless remarkable further advances are made in management techniques.

The problem is even more complicated. As demand for energy to feed the economic and technological segments of the still-growing industrialized nations mounts, there is increasing pressure to lower the standards for pollution control. Nuclear power is widely heralded as one important part of any possible solution to the energy squeeze. Advocates of nuclear power hope to find sites for power plants where there is abundant water for cooling. Nuclear power plants now in existence produce about 1,000 megawatts each and require cooling water in volumes of 30 to 50 million gallons per hour. There are few bodies of water or rivers in the continental United States that can supply this amount of water for once-through cooling to such power plants. The present hope is that these plants can be placed along the coasts, perhaps not on the shore at all but in the ocean, where there is abundant salt water for cooling. The plants, however, must necessarily be located in fairly shallow waters and will hence affect coastal fisheries. There is no possibility that these establishments will improve the fisheries; there are many reasons for believing that they will diminish them, perhaps greatly. The principal problem is the large volume of water that nuclear reactors use, pasteurizing it with heat.

Reactors also release toxic substances used to kill organisms that might foul their cooling coils. In addition, there is erosion of toxic metals from the reactors themselves in quantities that may approach several tons annually, as well as the continuous release of radioactivity. This latter problem is more severe in the oceans than on land because there is little possibility of cleaning up any offshore radioactive spill. Once radioactive nuclides are released into coastal waters, they will circulate in biotic systems and have the potential for affecting humans. This latter fact alone is sufficient reason to give serious pause to those who advocate offshore reactors. One large radioactive spill from such a reactor could render a segment of the coastal fisheries unfit for human consumption. Would the gain in energy be worth adding such a risk to other certain costs? Far from appearing as a boon, nuclear power looks more and more like an unacceptable burden.

Another example of the interrelationships between technology and natural systems helps to clarify this apparent dilemma. Rains over much of the eastern part of North America have become extremely acid. The acidity presumably comes from oxides of sulfur and nitrates formed in the combustion of fossil fuels. Apparently the burning of sulfur-containing oil and coal and the use of internal combustion automobile engines that fix nitrogen as a by-product have turned precipitation into a dilute mixture of sulfu-

Continued on page 88



Announcing ITT Collector Series: Two.

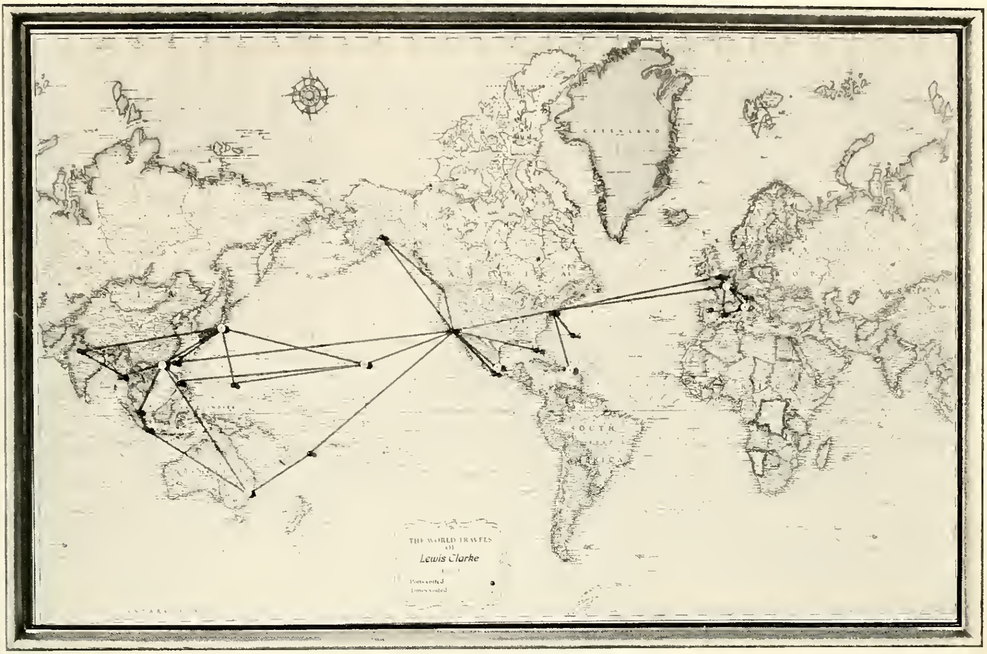
A second portfolio edition of unique international art for only $6.

As a result of the huge response to our first portfolio of art reproductions, we have just released *ITT Collector Series: Two*. It contains reproductions of ten specially commissioned works by international artists, reproduced in full color on heavy stock suitable for framing, measuring an average 20" x 15". A brochure on the artists is included.

To order your portfolio send coupon with check or money order for $6 today (no cash or stamps, please).
Allow 5 weeks for delivery, 12 weeks on overseas orders.

International Telephone and Telegraph Corporation **ITT**
P.O. Box 5052, Hicksville, New York 11802.
Please send me__________*ITT Collector Series: Two* for $6 each.
And/or__________*ITT Collector Series: One* for $5 each. My check or money order for $__________is enclosed.
NAME__________
NUMBER AND STREET__________
CITY__________STATE__________ZIP__________

WORLD TRAVELERS...here is your PERSONALIZED map



YOUR WORLD TRAVELS ADD TO YOUR PRESTIGE. NOW THE ROUTES OF ALL YOUR TRIPS BECOME A BEAUTIFUL DECORATIVE DISPLAY FOR YOUR HOME OR OFFICE!

Now you can display a decorative record of your world travels on your office or den wall. This beautiful, full color, 20" x 30" framed map is especially prepared by our artists to show exactly where YOU have traveled—every trip is charted according to the instructions you send to us. Your name is hand-lettered in the map legend. This is your very own custom-drawn, personalized travel record!

DELIVERED READY TO HANG! $19.95

This handsome map is printed on heavy artcraft stock. Gold-finish frame is wood (not plastic). When your framed map arrives, all routes are drawn, pins in place—it is ready for hanging—a beautiful addition to any room.

MAP MARKING KIT. We've even thought of your *future* travels; so, we include a map marking kit—place-pins, transparent ruler and marking pen—all you need to keep your map up-to-date.

DISPLAY YOUR TRAVELS. Everyone is interested in travel and your world travels do add to your prestige. You enhance your personal and business values by this tasteful display of your own travels. Often such a map discloses mutual interests with friends and business associates. Order your personalized world-travel map NOW!

DO-IT-YOURSELF ECONOMY KIT. Map is exactly the same EXCEPT that you mark-in the routes... and your name. Same beautiful, full-color map. Framed. Boxed and ready to hang—after you do the charting. We include Map-Marking kit described above. Shipped prepaid $14.95 (2 for $27.00)

MONEY BACK GUARANTEE. If you are not delighted with your map return it within 10 days for complete refund.

ORDER NOW

MAKES A GREAT CHRISTMAS GIFT!

THE CHART HOUSE
9255 Sunset Blvd., Suite 303 NH
Los Angeles, California 90069

Gentlemen: Please send me the maps as I've indicated below: CHECK CHOICE

☐ PERSONALIZED, Marked with name, hand-lettered and framed. Prices: 1 @ $19.95; 2 for $38.00; more than 2, $19.00 each.
Indicate number of maps________ @ $________each:
Total $________
IMPORTANT: For each map, send information on a separate piece of paper. Please PRINT person's name to be lettered on map and places visited in a numbered sequence for each trip. Example: (1) New York (2) Paris (3) Rome, etc.

☐ DO-IT-YOURSELF KIT, *Not* personalized or marked but otherwise identical to map above. Prices 1 @ $14.95, 2 for $27.00. More than 2, $13.50 each.
Indicate number of maps________ @ $________each:
Total $________

Note: Both maps offered include marking tools. MAPS MAKE IDEAL GIFTS: WE GLADLY SHIP TO ADDRESSES GIVEN. Please carefully write out complete instructions on separate sheets of paper for each person's name and travels. All maps shipped postpaid. Send check or money order. Sorry no C.O.D.'s.

My Name________
Address________
City________
State________ Zip________

The Great Dying

When the continents collided, marine life was devastated

FROM FANTASIA, © WALT DISNEY PRODUCTIONS.

About 225 million years ago, at the end of the Permian period, fully half the families of marine organisms died out during the short span of a few million years—a prodigious amount of time by most standards, but merely minutes to a geologist. The victims of this mass extinction included all surviving trilobites, all ancient corals, all but one lineage of ammonites, and most bryozoans, brachiopods, and crinoids.

This late Permian extinction was the greatest of several mass dyings that have punctuated the evolution of life during the past 600 million years. The late Cretaceous extinction, some 70 million years ago, takes second place. During that dying, some 25 percent of all families perished, and the dominant terrestrial animals, the dinosaurs and their kin, disappeared completely, thus setting the stage for the dominance of mammals and the eventual evolution of man.

No problem in paleontology has attracted more attention or led to more frustration than the search for the causes of these extinctions. The catalog of proposals would fill a Manhattan telephone book and include almost all imaginable causes: mountain building of worldwide extent, shifts in sea level, subtraction of salt from the oceans, supernovae, vast influxes of cosmic radiation, pandemics, restriction of habitat, abrupt changes in climate, and so on. Nor has the problem escaped public notice. I remember well my first exposure to it at age five: the dinosaurs of Disney's *Fantasia* panting to their deaths across a desiccating landscape to the tune of Stravinsky's *Rite of Spring.*

Since the Permian extinction dwarfs all the others, it has long been the major focus of inquiry. If we could explain this greatest of all mass dyings, we might hold the key to understanding mass extinctions in general.

During the past decade, important advances in both geology and evolutionary biology have combined to show which one of the many proposals is correct and even how it happened. This solution has developed so gradually that some paleontologists scarcely realize that their oldest and deepest dilemma has been resolved.

Ten years ago, geologists generally believed that the continents formed where they now stand. Large blocks of land might move up and down and continents might "grow" by accretion of uplifted mountain chains at their borders, but most geologists believed continents did not wander about the earth's surface—their positions were fixed for all time. An alternative theory of continental drift had been proposed early in the century, but the apparent absence of a mechanism for moving continents had assured its nearly universal rejection.

Now, studies of the ocean floor have yielded a mechanism in the theory of plate tectonics. The earth's surface is divided into a small number of plates bordered by ridges and subduction zones. New ocean floor is formed at the ridges

You're invited to the greatest party in the world.

To the Carnival in Rio, and on a 79-day Cruise to Four Continents aboard NAL's new Vistafjord, Jan. 21 from New York, Jan. 23, 1975, from Port Everglades.

It leaps, it swings, it dazzles, it dances. It explodes with color, gaiety and life. It's the one and only Carnival in Rio, the world's greatest party. And just one of the non-stop pageant of ship and shore attractions that parade before you for 79 days, on our Four Continents Cruise to 29 ports in South America, Africa, Europe and Asia.

See Rio and Recife, the Venice of Brazil. Set foot on St. Helena, where Napoleon was exiled, and rarely-visited Ascension Island. Adventure to the shores of Africa at Dakar, a kaleidoscope of colored robes and headdresses, the old and excitingly new.

Sip the wine of Madeira.

Delve back through centuries in Malta, Crete and Rhodes, in Izmir and Byzantine Istanbul.

Then cruise through the Black Sea to Yalta and Sochi in Russia, Constanta in Romania and Varna in Bulgaria, ports new even to world travellers.

And home via Greece, Italy, France, Spain, Mallorca and Morocco.

Our itinerary is unique, our ship is unique. The 25,000-ton Vistafjord. She's modern, beautiful, spacious, yet never overwhelming. The perfect size for long cruising. 154 of her cabins are single, and 102 of these are interconnecting. There's even a single sitting in her dining room.

And her European crew—350 of them for 500 fortunate passengers—provide a gala welcome you'll never forget and always want to come back to. (No wonder over 50% of our passengers are on their second NAL cruise or more.)

So ask your travel agent now about coming to the greatest party in the world: the Vistafjord's cruise to Four Continents, and the thrilling Carnival in Rio.

Vistafjord, the welcome-back ship

THE VISTAFJORD IS
REGISTERED IN NORWAY

RSVP

Ask your travel agent or NAL for information or reservations on the Vistafjord's FOUR CONTINENTS CRUISE from New York and Port Everglades, Jan. 21/23 1975. 79 days, 29 ports. To Barbados, Amazon/Para River, Belem, Recife, Bahia, Rio de Janeiro, St. Helena Island, Ascension Island, Dakar, Sao Vicente, Las Palmas, Madeira, Lisbon, Valletta, Herakleion, Rhodes, Izmir, Istanbul, Sochi, Yalta (U.S.S.R.), Constanta, Varna, Piraeus (for Athens), Palermo, Naples, Villefranche, Barcelona, Palma de Mallorca, Casablanca, Port Everglades, New York.

**Norwegian
America
Line**

29 Broadway, New York, N.Y. 10006
Tel. (212) 944-6900

super pilot
ASA
GOSSEN
EV ▲ LW

to get
better pictures
choose the better
"picture taker"

Serious photographers depend on a hand-held exposure meter for the accuracy, sensitivity and reliability they must have for their color and black & white shots. The SUPER PILOT CdS, by world-famed Gossen, ideally fills their needs. Try one and you'll see how a fine exposure meter helps 'take' better pictures.

world famed
GOSSEN®
SUPER PILOT
CdS EXPOSURE METER

SPECIFICATIONS:
The **Super Pilot CdS** accurately measures reflected or incident light; two full measuring ranges: Normal and Low Light Scales; ASA 6 to 12500; f/1 to f/45; 1/1000 sec. to 2 hrs; EV − 6 to + 24; Cine from 8 to 128fps.

At better photo dealers or write for literature.
KLING PHOTO COMPANY DIVISION OF Berkey PHOTO INC.
P.O. Box 1060, Woodside, N.Y. 11377

Sabena's African wildlife tours.

Sabena has been flying in and to Africa for half a century. So when it comes to African wildlife and safari tours, you can be sure we really know our way around.

Let us take you to places like the lion-filled Serengeti; to Tsavo National Park, home of big game; or to the hippo colonies of Mzima Springs beneath Mt. Kilimanjaro. Sabena offers a choice of 23 tours from 15 to 63 days. For a surprisingly small sum, you can safari in Africa's great game parks and bird preserves.

Discover Africa — the last different place — with Sabena. See your travel agent, call Sabena (see Yellow Pages), or fill in the information below and send it to Sabena Belgian World Airlines, Holiday Abroad Manager, 125 Community Drive, Great Neck, N.Y. 11021.

HOLIDAY® ABROAD SABENA belgian world airlines

Name____________________
Address____________________
City__________State______Zip______
My travel agent is____________________
NHO

as older portions of the plates are pushed away. To balance this addition, old parts of plates are drawn into the earth's interior at subduction zones.

Continents rest passively upon the plates and move with them; they do not "plow" through solid ocean floor as previous theories proposed. Continental drift, therefore, is but one consequence of plate tectonics. Other important consequences include earthquakes at plate boundaries (like the San Andreas Fault running past San Francisco) and mountain chains where two plates bearing continents collide (the Himalayas formed when the Indian "raft" hit Asia).

When we reconstruct the history of continental movements, we realize that a unique event occurred in the latest Permian: all the continents coalesced to form the single supercontinent of Pangaea. Quite simply, the consequences of this coalescence caused the great Permian extinction.

But which consequences and why? Such a fusion of fragments would produce a wide array of results, ranging from changes in weather and oceanic circulation to the interaction of previously isolated ecosystems. Here we must look to advances in evolutionary biology—to theoretical ecology and our new understanding of the diversity of living forms.

After several decades of highly descriptive and largely atheoretical work, the science of ecology has been enlivened by quantitative approaches that seek a general theory of organic diversity. We are gaining a better understanding of the influences of different environmental factors upon the abundance and distribution of life. Many studies now indicate that diversity—the numbers of different species present in a given area—is strongly influenced, if not largely controlled, by the amount of habitable area itself. If we count the number of ant species living on each of a group of islands that differ only in size (being otherwise similar in such properties as climate, vegetation, and distance from the mainland), we find that, generally, the larger the island, the greater the number of species.

It is a long way from ants on tropical islands to the entire marine biota of the Permian period. Yet we have good reason to suspect that

Every Wednesday at 3:30 Exxon analyst Charles Lee and 12-year-old Peter Lewis talk about the future.

Charles Lee and Peter Lewis are part of Project LIVE—a tutoring program in which Exxon employees participate. The program is designed to help junior high school students make the grade—in school and at a good job in the future. Mr. Lee is one of a large group of Exxon employees who participate in Project LIVE. Peter Lewis was selected by his own school based on his ability to benefit from Project LIVE's "one-to-one" tutoring.

After school each Wednesday, Peter comes to Charles' office where they begin each session with class work. It may be reading, writing, arithmetic—or any other subject Peter needs help with. Charles goes over Peter's homework assignments. Helps him bone up for tests. They even talk about Charles' responsibilities as an Exxon manpower planning and placement analyst—and Peter's responsibilities as a leader on the school basketball team.

Then it's into the future as Charles takes Peter for a step behind-the-scenes—into the world of work—where Peter gets a chance to see the skills needed in modern businesses and corporations like Exxon. Here, reading and writing and arithmetic come alive—proving to Peter that his careful attention to school work today can pay off in a good career later.

While Project LIVE is one of the most personal and important ways Exxon is aiding education, it's still only one way—there are dozens of others. Including Exxon Education Foundation grants to colleges and universities. Bilingual schools for Chinese immigrants. Block schools for Spanish-speaking communities. Service station management training courses for minorities. In-class TV series for elementary school students. A program that sends black Exxon executives to black colleges as visiting professors. And many more.

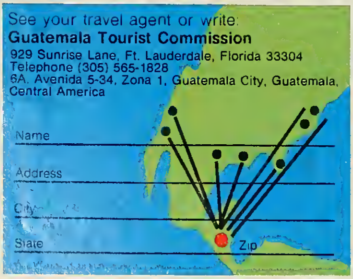
As a group, Exxon-sponsored programs to aid education are helping students from grade school through grad school—and enabling some people to become students for the first time in their lives.

EXXON

There are 21 different countries in Latin America, but in one country you can see what most of them are famous for.

Guatemala

Native handcrafts
Ancient Indian civilizations
Lakes and volcanoes
Vast cattle lands
Spanish colonization
Ultra modern cities



See your travel agent or write:
Guatemala Tourist Commission
929 Sunrise Lane, Ft. Lauderdale, Florida 33304
Telephone (305) 565-1828
6A. Avenida 5-34, Zona 1, Guatemala City, Guatemala, Central America

Name
Address
City
State
Zip

If you're thinking about going to see some part of Latin America, come to Guatemala and see it all.

GIT tours for 4 days and 3 nights start at $196.00 from Miami and New Orleans. From Los Angeles $321.00. From Houston $253.00.

area might have played a major role in the great extinction. If we can estimate organic diversity and area for various times during the Permian (as the continents coalesced), then we can test the hypothesis of areal control.

We must first understand two things about the Permian extinction and the fossil record in general. First, the Permian extinction primarily affected marine organisms. It did not strongly disturb the few terrestrial plants and vertebrates then living, and diversity of land organisms may have increased at the time. Second, the fossil record is very strongly biased toward the preservation of marine life in shallow water. We have almost no fossils of organisms inhabiting the ocean depths. Thus, if we want to test the theory that reduced area played a major role in the Permian extinction, we must look to the area occupied by shallow seas.

We can identify, in a qualitative way, two reasons why a coalescence of continents would drastically reduce the area of shallow seas. The first is basic geometry: If each separate land mass of pre-Permian times were completely surrounded by shallow seas, then their union would eliminate all area at the sutures. Make a single square out of four square graham crackers and the total periphery is reduced by half. The second reason concerns the mechanics of plate tectonics. When oceanic ridges are actively producing new sea floor to spread outward, then the ridges themselves rise high in parts of the ocean that previously were deep. This displaces water from the ocean basins, world sea level rises, and continents are partly flooded. Conversely, if spreading diminishes or stops, ridges begin to collapse and sea level falls.

When the continents collided in the late Permian, the plates that carried them "locked" together. This stopped new spreading. Ocean ridges sank and shallow seas withdrew from the continents. The drop in sea level alone did not bring the drastic reduction in shallow seas that followed. The ocean floor does not plunge uniformly from continental shore to ocean deep. Each of today's continents is generally bordered by a wide continental shelf of shallow water, beyond which the continent slopes steeply to the ocean floor. During the late Permian the sea level may have fallen far enough to expose the entire continental shelf, thus eliminating most of the world's shallow seas.

Thomas Schopf of the University of Chicago has recently tested this hypothesis of extinction by reduction in area. Studying the distribution of terrestrial and shallow-water rocks, he estimated the continental borders and the extent of shallow seas at several times while the continents were coalescing during the Permian. Then, through an exhaustive survey of the paleontological literature, he counted the numbers of different kinds of organisms living during each of these Permian times. This gave him data on the numbers of organisms at different times as the shallow seas diminished.

Daniel Simberloff of Florida State University then showed that the standard mathematical equation relating numbers of species to area fits these data very well. Moreover, Schopf showed that the extinction did not affect certain groups differentially; its effects were evenly spread over all shallow-water inhabitants.

In other words, we do not need to seek a specific cause related to the peculiarities of a certain animal group to explain extinction. The effect was general. As shallow seas disappeared, the ecosystem, so rich with life in pre-Permian times, simply lacked the space to support all its members. The bag became smaller and half the marbles had to be discarded.

Area alone is not the whole answer. Such a momentous event as the fusion of a single supercontinent must have entailed other consequences detrimental to the pre-Permian ecosystem. But Schopf and Simberloff have provided persuasive evidence for granting the major role to the basic factor of space.

That paleontology's outstanding dilemma should be solved with the help of advances in two other disciplines is not surprising. When a problem has proved intractable for more than 100 years, it is not likely to yield to more data collected in the old way and under the old rubric. Theoretical ecology and plate tectonics have provided paleontologists with the right questions to solve their hardest riddle. ☐

Strangely beautiful cruises to forgotten islands. Indonesia adventures. 5 to 14 days, 2 to 7 ports.

Sail from Singapore, Bali or Jakarta.

Throughout 1974, the elegant new m.s. Prinsendam weaves a magic spell to haunting places. Join her for cruises of 14, 10, 9, 7 or 5 days. It depends on how many of these exotic ports you choose: Singapore, Penang, Belawan, Sibolga, Nias, Jakarta, Bali, Surabaya. Rates from only $375 for 5 days, from $1050 for 14 days.

Or take a tour package (23 to 34 days) with one price for air and cruise fares, hotels, meals, everything. From $1995. See your travel agent or mail the coupon. The m.s. Prinsendam is registered in the Netherlands Antilles. Cruise fares based on per person, double occupancy, subject to availability.

Holland America Cruises, Pier 40 North River, N.Y., N Y. 10014. Tel. (212) 620-5101 or toll-free at (800) 221-6657

160-PSB-A
You may never want to get off.

Holland America Cruises

Please send me your 1974 Singapore/Bali brochure.

Name__________
Address__________
City______ State______ Zip______
Travel agent__________

The dinner: delicious.
The mood: easy.
The dessert: Kahlúa & Ice Cream.
IMPORTED FROM SUNNY MEXICO
KAHLÚA
LICOR DE CAFÉ

Your favorite ice cream. An ounce of Kahlúa. A sprinkle of shaved chocolate. And you've got it made!

The Kahlúa recipe book is free for the sending. Because you deserve something nice.

Kahlúa 53 Proof. Coffee Liqueur from Sunny Mexico. Maidstone Importers, 116 No. Robertson Blvd., Los Angeles, Calif. 90048.

Do 18th and 19th century things have a place in our century?

From the 18th and 19th centuries come the warm and beautiful designs in furnishings, tools and accessories that are working a new revolution in the quality of life of twentieth century man. Read here how the Early American Society can help you bring the beauty of early America into your family's life.

The Early American Society Story

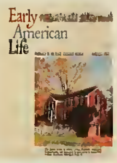
Millions of present-day Americans are stimulated by the warmth and beauty of young America. Some wish to re-create in their homes a total atmosphere that recalls Colonial days. Others practice the skills that created the objects and art of the period. Still others wish to absorb the background - the "social history" of the people of that day through understanding how they lived, loved, and worked.

The Early American Society, founded in 1969, is dedicated to bringing the total story of American social history of the period, 1700-1850, to those who wish to use it in their lives. We accomplish this through several programs including publishing EARLY AMERICAN LIFE six times each year. Our magazine features articles, lavishly illustrated, on arts, crafts, antiques, restoration, travel to historic sites, and all related subjects of interest to members.

To foster reading of books on these subjects, the Early American Society Book Program offers the latest books of leading publishers at discounts up to 25%. Heirloom quality reproductions of outstanding early furniture items are commissioned by the Society and made available only to members in limited editions. Group travel and historical assemblies offer members the opportunity to enrich themselves under the guidance of qualified professionals.

If your special early American interest includes antiques, restoration, arts, crafts, social history, or simply the warm style of the period, 1700-1850, your membership in the Early American Society may become one of your most valuable possessions. We are certain enough of this to offer a no-risk membership. Just mail the application below or the accompanying card. You pay only after your mind is made up that you are satisfied with your membership. Annual dues are $6.00.

Early American Life



Member Service Center The Early American Society
3300 Walnut St., Boulder, Colo. 80302

Please enroll me as a member in the Early American Society and bill my annual dues of $6.00 after I have received my first issue of EARLY AMERICAN LIFE. I understand that if the first issue does not live up to my expectations I may cancel without further obligation.

Name______________________________

Address______________________________

City______________ State________ Zip________

7068

Do 18th century things
have a place
in our century?

Both antiques and reproductions are the concern of *Early American Life*, our official magazine. Travel, art, craft, and the telling of the story of the people of young America are our concern too.

LIVING HISTORY

Early American Society

Please enroll me as a member of the Early American Society and bill my annual dues of $6.00 after I have received my first issue of EARLY AMERICAN LIFE. I understand that if the first issue does not live up to my expectations I may cancel without further obligation.

Name ____________________

Address ____________________

City ____________________

State __________ Zip ________

7068

1.00
Early American Life

LIVING HISTORY

BUSINESS REPLY MAIL
No Postage Stamp Necessary if Mailed
in the United States

POSTAGE WILL BE PAID BY

FIRST CLASS
PERMIT
NO. 1016
BOULDER,
COLO.

Membership Director
Early American Society
Member Service Center
3300 Walnut St.
Boulder, Colo. 80302

A Naturalist at Large

The Flowing Well of Life

Population binges, followed by sobering decimation, have produced a fluid matrix for man's unsteady evolution

by Raymond B. Cowles

All animals experience occasional bad years in which either food, space, or shelter is inadequate to insure survival for much of their populations; drastic declines in numbers are a usual, necessary adjustment to diminished resources. Before shelter building and toolmaking came into being, man, both as an individual and as a species, survived about as precariously as any other animal. *Homo sapiens* required a plethora of offspring to fill the population gaps caused by periods of calamity. The greatest potential fertility of ancient men and women had to be realized simply to overcome the forces of decimation.

With the advent of cave dwelling came superior protection from the elements. Man multiplied as high rates of infant mortality began to decrease and more individuals survived longer through the child-producing years. Crude shelters, into which families could crawl before a storm came, followed. Such families survived in ever greater numbers, while those that were unimaginative or incapable of emulation were soon numerically inferior and less powerful.

By degrees, for example, through the use of digging sticks instead of fingernails to procure edible bulbs, people obtained more food; therefore the inventors of the earliest tools experienced greater survival. In succession came the use of still other tools and weapons, and early man progressed from hand-held rocks to clubs, from fire-hardened sticks to stone-tipped spears to bows and arrows, which reached beyond the limitation of arm's length hunting with its dangers from wounded prey. Each advance resulted in an increased need for food, shelter, and land from which to gather natural harvests or on which to hunt.

As man's numbers and needs grew prodigiously and inexorably, times of tormenting scarcity returned, demanding new techniques for expanded living. The waging of

Unusual travel plans for the more intellectually superior traveller.

If you are a thinking person, The Office of Academic Liaison has exotic destinations designed to excite your inquisitive mind.

Our ultra specialized itineraries are truly travelogues of art, nature, archeology and other scientific adventures. For your added enlightenment most tours are lead by a personage of note in that field.

Plan an odyssey you'll not likely forget.

PIN-TAILED WHYDAH – ETHOPIA NATIONAL PARKS

Write: Office of Academic Liaison
640 Cathcart St. Suite 307
Section NHB, Montreal
Canada, H3B 1M3

Please forward more information regarding your unusual destinations without obligation

Name__________

Address__________

City__________

State__________

Zip Code__________

Office of Academic Liaison
640 Cathcart, Suite 307
Section NHB, Montreal
Canada, H3B 1M3

war to dispossess others of their food, their tools, and their lives was one consequence. The tragedy of man's technological progress is that all his advances are quickly rendered obsolete by a flood of surviving progeny.

What man has only dimly realized is that he is beset by the greatest force in living things: the universal power of every form of life to out-reproduce chronic attrition by death and the more spectacular catastrophes of famine, storms, disease, and war.

Every plant and animal, from the lowest to the highest, reproduces according to its average death rate through all the vast span of time; the magnificent and creative flow of life must never cease nor can death for long remain behind. No form of life can reduce or increase its procreation without denying life to some interrelated organism.

The living world is wholly bound together and is dependent on the circulation of nutrition created by the never-failing matrix of life and death, the unimaginably grandiose and tragic sequence of birth to ultimate reconversion and dissolution back to the basic molecules.

The Greeks, had they perceived the course of life and evolution through the natural processes of selection, might have named the basic process *krene*, "the flowing well," or *biokrene*, "the flowing well of life." Our generation of scientists speak merely of the superfluity of reproduction, of its excess capacity, of expendable progeny, or supernumerary offspring. None of these terms portrays the universality of the phenomenon of life and death and its indispensability to both individual survival and species evolution by natural selection, or of its fateful tragedy to individual men and women while creating the need for ingenuity, discovery, and invention in the social progress of our species.

The disastrous consequences of any dislocations of these natural laws have dogged every step of man's long and weary path in search of a final respite from hardship and disaster. The biokrene is the nemesis that has lain in wait for every civilization and, in the end, precipitated its doom.

The story can be traced step by step from the days of expanding numbers and an ephemeral reprieve through migration to unclaimed living areas. It is told in the perfecting of new tools, the invention of boats and the exploitation of aquatic resources, and in migrations across seemingly impassible barriers to the ends of the earth. It is told, too, in the story of overexploitation of the soil through overgrazing; in the eroded and salinized soils of the Euphrates and the Tigris valleys; in the ruins of Carthage; and in the stony, barren hills of once mighty Portugal and Spain.

But so long as man has endured, just so long has his painfully acquired backlog of scientific and technological ingenuity discovered new and unsuspected resources, thereby supporting life even better and in greater numbers and making it more secure and self-assured. And the consequence of every advance has been still greater multiplication and, of late, an exponential increase in the rate of growth of consumers, until all resources are being exploited.

Man could have chosen to keep his numbers down, increase life expectancy, and devote the world's resources to better living and a peaceful coexistence with his fellows. Instead, multiplying without inhibition, he has despoiled the world through overexploitation and pollution.

But we cannot go back; we cannot even safely retreat before the dangers of domestic calamity or war from external sources. We have gone too far along the road of billions of "souls." Only a moratorium on births, a period of sacrificial childlessness that will redeem our reproductive folly, can stave off a plunge back to the life of Neanderthal man.

The great tragedy of mankind is that the more we realize ambitions for the good of ourselves and for others, the sooner we will be humbled by the as yet invincible biokrene. Although we may not become extinct as a species, technology and science will become but a frustrated Promethean dream of a golden era that can never quite be attained—unless we become content to live with fewer of our kind and learn to drink moderately from the well of life.

Raymond B. Cowles is professor emeritus of zoology at the University of California at Los Angeles.

The Great Explorers

Only 1600 American Collectors may possess the beauty and innovative artistry of this fine 10-medal series.

Pre-Announced, Extremely Limited Editions in Bronze, Silver, and Gold on Silver Vermeil

Vermeil limited to just 200 sets:
24 Karat Gold on pure Silver; antique patina

Silver limited to just 600 sets:
.999 fine Silver with a hand-finished, antique patina

Bronze limited to just 800 sets:
Solid Bronze, the traditional metal of medallic art, with an unusual, deep-toned patina personally selected by the sculptor.

Each strictly limited edition is hallmarked and serially numbered for personal registration. While the weight of each medal will vary due to differences in relief, the silver and vermeil collections each contain over 10,000 grains of .999 fine silver. [480 grains per troy ounce]

Your Collection May Be Purchased by Subscription
Both the Vermeil and the Antique Silver Editions may be delivered to you at the rate of one medal every month. (The Bronze Edition, because of its significantly lower cost, is only available as a complete set.) Should you decide to purchase your collection on a subscription basis, your initial payment for the first medal guarantees that no *matter how high the price of gold and silver may rise* in international markets, you will pay only the issue price listed here for each succeeding medal in the series.

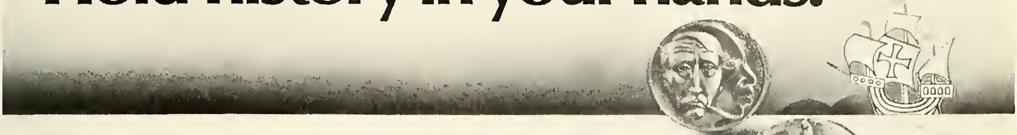
The Great Explorers

Marco Polo/Asia
Christopher Columbus/America
Vasco daGama/India
Ferdinand Magellan/Circumnavigation of the Globe
James Cook/Australia
David Livingstone/Africa
Adolf Erik Nordenskjold/Northeast Passage
Robert E. Peary/The North Pole
Roald Amundsen/The South Pole
Sven Hedin/Central Asia

CRISTOFER COLUMBUS

Hand-Tooled Oak Display Chest Included
This handsome showcase will be provided for each Explorer Collection. On subscription reservations, the chest will be delivered with the third medal. A biography of each explorer will accompany the showcase.

Hold history in your hands.



The World's Great Explorers and their Historic Voyages Captured in Sculptured Art Medals with extremely small Limited Editions.

They conquered the wilderness. Prevailed over the forces of nature. Ignored danger and deprivation to explore the unknown. To stretch the bounds of human knowledge. To attain what others believed to be unattainable goals.

Men like Christopher Columbus, impelling a mutinous crew ever onward across an unending sea toward a foreboding horizon. Or Robert Peary, driving himself, his men, and his primitive dog-drawn sleds across a barren, uncharted ice pack to reach the vast wasteland of the North Pole.

Columbus and Peary were but two of The Great Explorers. Their exciting discoveries—and eight other momentous explorations—have been transformed into enduring art by the creative genius of the great Finnish sculptor, Kauko Rasanen. In a most unusual medallic tribute, Rasanen has captured the personalities of these men-above-men in dramatic, high relief portraits, while on the reverse of each medal he offers his own symbolic interpretation of each great discovery. The bold, impressionistic styling of his imagery, his use of concave and convex surfaces, his transformation of positive and negative images, has created a *truly imaginative art medal series style that has never before been seen or offered to the American Collector.*

You can hold history in your hands; share in this artistic and historic experience. You can own this unique collection of ten sculptured art medals by filling in and mailing the accompanying coupon. To avoid disappointment, please don't delay. *Editions are extremely limited.*

Christopher Columbus Medal Shown Actual Size 1¾" diameter

Order today— Edition will not be extended beyond the announced limits.

MEDALLIC ART COMPANY, this nation's preeminent medallic sculpture producer, is introducing its first medal series direct to the collector public. This special offering meets Medallic's exacting quality and artistic standards and is backed with a "complete satisfaction or your money back guarantee."

Medallic Art Company

Medalist to America since 1900
Old Ridgebury Road, Danbury, Conn. 06810

Medallic Art Company, Dept. NH
Old Ridgebury Road, Danbury, Conn. 06810
Gentlemen:

Please reserve my personal Great Explorer Collection by Kauko Rasanen.

Edition	[A] Complete Set	[B] By Subscription
___Gold on Silver Vermeil	$415 ☐	$45 each medal ☐
___Antique Finish (.999) Silver	325 ☐	35 each medal ☐
___Antique Finish Solid Bronze	75 ☐	not available

[A] I enclose $______, plus my state sales tax, in full payment for the set indicated above.

[B] I enclose $______, plus my state sales tax, to cover the cost of the first medal. I agree to pay the same amount for each subsequent medal promptly upon being invoiced on a monthly prepayment basis.

Prices include shipping and showcase.

Charge to: ☐ Diner's Club ☐ American Express ☐ Bank Americard ☐ Master Charge

Note: Charge privileges apply to complete set [A] purchases only.

Number______________________

Expiration Date______________________

Signature______________________
(Not valid unless signed)

Name______________________

Address______________________

City______________________State________Zip________

He wants oil without oil spills. So do we.

Meet Walt Welles, conservationist, former navigator on an oceanographic schooner. Loves the sea. Worries over what man might do to it. Hates oil spills.

But he also likes what petroleum does for his enjoyment of nature. Quick-drying sails made from petrochemical feedstocks. A maintenance-free fiberglass hull, also petroleum-derived. An auxiliary engine that couldn't go anywhere without diesel fuel.

So he wants conservation—plus adequate supplies of petroleum. Which, to Walt Welles, is simply a matter of realistic trade-offs on conservation issues involving oil.

Offshore drilling? "Yes, within reason," he says. "I certainly don't want to look at nothing but oil wells when I put to sea. But I'm told a single production platform today does the job of many earlier ones." We could also tell him some of our plans for the future, like producing oil on the bottom of the sea. In many cases with no visible platforms at all. This new system is being tested right now.

As to building deepwater ports to handle very large tankers: "I'm excited, as a conservationist, that crude oil could be unloaded at a buoy 10 or 20 miles out to sea, then carried by submarine pipeline to storage tanks ashore. That means fewer vessels in our ports. Fewer risks of collision and oil spills. And no need to dredge our harbors, damaging the eco-system."

It also means that we'd be able to handle our imported crude oil in the most economical way.

"The trick," Welles says, "is to make the ocean work for all of us. Yield her fish *and* her oil. Without messing up the critical balance of nature. Or the beauty we all love."

Well said, Walt. We couldn't agree more.

Mobil®

© 1974 Mobil Oil Corporation

Beautiful

Gamblers of the Biosphere

Oncidium Red Velvet, Jamaica and Dominican Republic

One of the most successful plant families, the more than 20,000 orchid species have evolved an elegant technique for finding their special places on earth

by Edward S. Ayensu

Color photographs by Kjell Sandved

Cherished by laymen and scientists, orchids are the best loved of all the flowering plants. They belong to the largest plant family, with an estimated 20,000 to 35,000 species. Orchids vary not only in their form and structure but also in the habitats they occupy throughout the world. Some live on the ground in temperate regions; others cling to trees high in the canopy of humid tropical rain forests. What were the origins of these complex plants and how were they dispersed over the globe?

Phytogeographers and evolutionists generally agree that orchids appeared early in the Tertiary period, some 65 million years ago, when the global environment was stable. The plants probably originated in the region now covered by tropical Asia, with Polynesia as the western margin of the Pacific and South America, the eastern. The current continents of Asia and South America are the result of a large landmass division that took place in the middle of the Tertiary period. Subfamilies of the orchid family may have had a common origin, but they subsequently developed independently in different areas. For example, of the four genera that constitute the subfamily Cypripedioideae (relatives of lady's slipper or-

Epidendrum ellipticum. West Indies and Brazil

chids), two, consisting of about sixteen species, inhabit the tropics of South America; a third genus (approximately fifty species) grows in Asia; and the fourth (about fifty species of lady's slipper orchids) is found in the north temperate regions of the world.

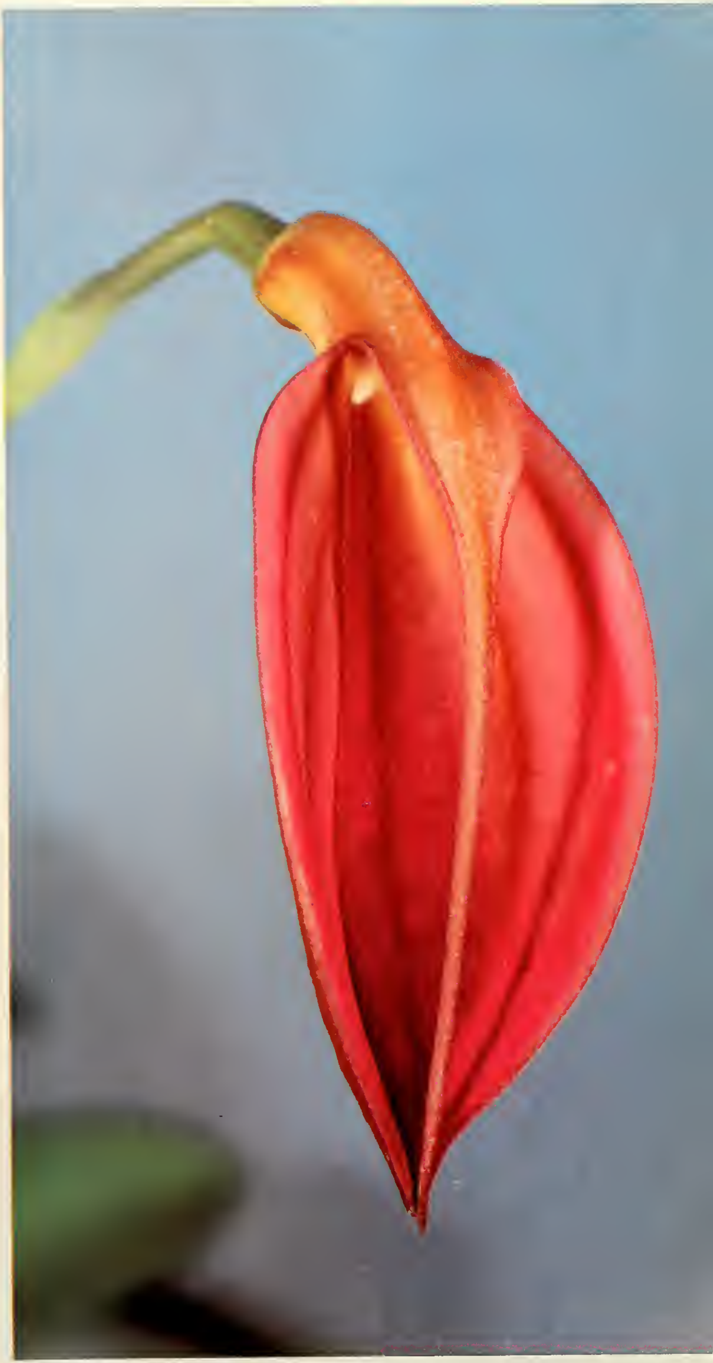
Of the 750 to 800 genera of orchids, only about 12 (comprising about 850 species) occur in all three tropical regions of Asia, America, and Africa-Madagascar. Somehow the seeds of these species must have dispersed from their continent of origin to the other land masses.

In recent years the subject of plant dispersal has received great attention, especially the long-distance movement of seeds and fruits by means of ocean currents, wind, birds, and man. All of these dispersal phenomena have affected the distribution of plant life. With respect to orchids, however, some major biological factors influence long-distance dispersal.

Orchid seeds are among the smallest produced by flowering plants—some are as small as 0.3 millimeters long. Each seed capsule contains hundreds of thousands of seeds. A mature capsule of *Cymbidium tracyanum* carries about 850,000 seeds. There are species of *Cymbidium* and *Maxillaria* that have as many as 1.5 million seeds per capsule, and some species of *Cattleya*, up to 5 million. If the viability of all orchid seeds was even 10 percent and if growing conditions were favorable everywhere, the earth's surface would be covered with orchids in a short time.

Orchid seeds differ in their rate of development within the capsule and also in the time of their release. The seeds of *Listera cordata* are sometimes released from the lower capsules of a stalk while the upper flowers are still open and apparently functional. Seeds may also be released from fruits whose flower parts are still functional.

The embryos of orchid seeds are extremely reduced in comparison with those of most other plants. Consequently, their early germination stages are different. Embryos of all orchid species first enlarge to produce an oval mass of cells, or



Masdevallia ignea, Colombia

Gongora galeata, Mexico

protocorm, which is frequently covered with absorbing hairs called rhizoids. The protocorms of some terrestrial species develop chlorophyll as the embryos swell and begin to grow. These photosynthetic protocorms develop comparatively rapidly, but some species may not develop chlorophyll for months or even years after growth has commenced. The successful germination of such small, rudimentary embryos is difficult even if they find a suitable habitat.

To insure their survival, the protocorms of almost all orchid species must come in contact with a fungus. The fungus—generally different for each species—grows into the cells of the developing protocorm. The orchid seedlings then absorb the invading filaments of the fungus. In this curious symbiotic relationship between two diverse plant groups, the fungus supplies nutrition for the orchid and the orchid supplies a habitat for the fungus. In many cases the presence of a fungus is essential since certain orchids are devoid of any green tissue and are therefore unable to carry on photosynthesis.

Some orchidologists discount the possible long-distance dispersal of orchids because, unlike most other plants, the seeds are devoid of the food-storing tissue called endosperm; thus the seeds are too small and not adapted for extensive transoceanic dispersal. These scientists believe that the seeds cannot be transported by wind across the oceans because they desiccate rapidly, and that if immersed in seawater for a long time, they will lose viability.

While these observations are valid, some studies indicate that seeds of, for example, *Cypripedium*, will remain viable after eight years of storage in a cool microenvironment. Other studies have proved that seeds of the pink grass orchid, *Calopogon pulchellus*, were viable after five years of storage. Quite possibly some of the billions of orchid seeds produced could find protection among other objects that are commonly moved long distances by ocean currents.

Probably some of the seeds also could be quickly transported across the oceans by winds. In recent years phytogeographers have begun to understand the significance of plant dispersal by jet streams—very powerful, high-altitude winds that sometimes reach speeds of 300 miles per hour. These winds circulate around the much slower winds that move from one continent to another. I believe that some orchid seeds could be transported across the oceans by jet stream winds in a short time.

Among the orchid genera and species in both Africa and South America, the genus *Manniella*—a rare terrestrial orchid with distinctive yellowish flowers—has the most spectacular distribution. Of its two distinct species, *M. gustavia* occurs in the dense forest of West Africa's Cameroon Mountains and *M. americana* in the Guayana highlands of northeastern South America. Since this genus probably did not migrate by land between West Africa and South America, I speculate that migration took place by long-distance wind dispersal. The restrictive distribution of the genus may be due exclusively to the strict ecological requirements of the plants, provided only by the Guayana highlands and the Cameroon Mountains.

Another possible dispersal agent is the bird. Leslie Garay of Harvard University points out that seeds can become attached to the feathers of migrating birds, although orchid seeds would probably dry out and not survive.

In my opinion, birds could act as a dispersal agent by carrying orchid seeds in mud on their feet. By this method, the billions of orchid seeds produced over millions of years could have come in contact with the millions of migratory birds, presenting a strong chance for the long-distance transport of seeds and their subsequent establishment in the relatively small ecological niches needed to accommodate orchid seedlings.

Assuming the seeds crossed the oceans successfully and came in contact with the required fungus, how were they deposited in a satisfactory ecological substratum? One explanation is that the mineral requirements of germinating orchid seeds and the growth of their seedlings are not substantially different from those of other flowering plants. Also, despite their delicate appearance, orchid seedlings can withstand comparatively harsh environmental conditions; nearly 80 percent of all orchids grow in tropical latitudes with altitudes ranging from sea level to more than 6,000 feet.

Aside from intercontinental dispersal of orchids, there are some interesting intracontinental distributions of species that may have resulted from geologic changes in the Tertiary period and subsequent divergent evolutionary and phylogenetic developments.

Many botanical and geologic studies of tropical America have indicated that 50 million years ago, like today, the Amazon and Paraguay basins were low lying. Large quantities of ancient marine sediments have been found near the coasts of western Venezuela and at the mouths of the Amazon and La Plata rivers. Such ecological conditions did not then, and do not now, permit a large colonization of orchids in the Amazon and Paraguay basins, with the possible exception of the Guayana Shield area. Eastern and southeastern Brazil, however, have for the past 50 million years maintained fairly uniform climatological and ecological conditions that have led these regions to become rich in orchids.

Over the ages, there has been a tremendous interchange of orchid species between Central and South America. Paleoclimatic history indicates that during the Tertiary the two continents separated from each other on a number of occasions when portions of each land mass sank. The orchid flora of Panama, however, is similar to that of the lowland region near the Andes, extending from Colombia to Bolivia, and to that of western Venezuela. The orchids of Costa Rica exhibit a mixture of both Central and South American elements, and the orchid floras of Cuba, Haiti, the Dominican Republic, and Puerto Rico have much in common with those of Central America. The orchids of the Lesser Antilles—notably Guadeloupe, Dominica, Martinique, and

Renanthera monachia, Burma

Trinidad—are decidedly more closely related to the South American orchids.

No doubt the interchange of orchid species between Central and South America, and even within each continent, has been a slow process, one that must have begun in the Ice Age and continued during the interglacials. Evidence suggests that there were four or possibly five major glaciations, each taking some 90,000 years to reach its peak. Although the effect of these glacial fluctuations on the orchid flora is not clear, scientists believe that many orchid species were established in the Amazon region during the Pleistocene when the basin gradually began to fill with sediments brought down by Andean rivers.

The distribution of orchids within tropical Africa is much more straightforward than in the American tropics. This is because the area in Africa where orchids grow is ecologically more uniform than the American tropics. In Africa, orchid species are most abundant in the region extending from ten degrees north latitude to ten degrees south latitude; in the American tropics, the latitudinal range is greater: from about twenty-four degrees north latitude to twenty-four degrees south latitude.

A comparison of the orchids in Africa with those in nearby Madagascar shows that some two thousand species exist in either one or the other of the areas, but only eleven of these species exist in both places. The relative proximity of Africa and Madagascar should have facilitated the interchange of their flora and fauna—and most certainly their orchid floras—but such is not the case. To complicate this unsolved problem, there are several instances of orchid species inhabiting both South America and Madagascar, but not mainland Africa itself.

The distribution of orchids in tropical Asia presents an equally fascinating dispersal story. Such areas as New Guinea, Polynesia, and Australia may appropriately be included with the tropical region of east Asia, since the Asiatic genera have spread throughout this whole area. New Guinea, for example, possesses a large number of endemic orchid flora. Several of its species and those of Southeast Asia have found their way to the Polynesian Islands, but not all the Polynesian Islands are orchid rich.

The Hawaiian archipelago has a diverse flora but is very poor in orchids, with only three endemic genera represented. *Anoectochilus*, a genus of about eight species, extends from southern India across Malaya and northeastward across Polynesia, with Hawaii as the northernmost Pacific limit and home of one species, the terrestrial *A. sandwichensis.*

Occurring in the same habitat as *Anoectochilus*, in the humid lower forest zone of all the islands, is a single native species, *Liparis hawaiiensis.* The genus *Liparis* comprises more than 120 species scattered over the tropic and temperate regions of the world. Some of the species are terrestrial; others, epiphytic. In Hawaii, *L. hawaiiensis* is epiphytic; in eastern Africa, however, a different species of the same genus, *L. neglecta*, grows on the ground in the leaf litter of the forest floor. In parts of Kenya, *L. neglecta* is an epiphyte found at altitudes above 7,000 feet.

In Hawaii, the genus *Habenaria* is represented only by *H. holochila,* which is endemic to the summit bogs of a number of Hawaiian mountains. Those bogs are situated in the cloud belt at elevations of 3,000 to 6,000 feet. Geologic history indicates that the present islands of Hawaii—a chain of volcanoes that erupted from beneath the ocean—have always been isolated from continents and large land masses. The Hawaiian region doubtlessly rose in the ocean long after the final burst of orchid migration and subsequent speciation in tropical Asia, yet the seeds of a few orchid species somehow reached these mid-Pacific islands.

Australia, New Zealand, New Caledonia, and the New Hebrides form a more or less homogeneous unit, having many orchids that emigrated from Southeast Asia, especially in the *Dendrobium* and *Cymbidium* groups. Species belonging to the neottiod and diuridoid groups are mostly native to this area and must have spread northward into the tropics. Australia has nine endemic genera and some thirty-two species. Tasmania has only one endemic genus, while New Zealand has two.

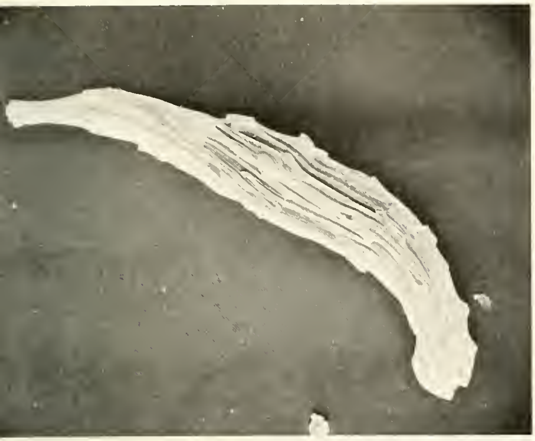
The Australian orchids have followed several levels of migration. The ranges of some species probably do not extend beyond the areas where they originated. Others have spread to New Guinea and beyond to Southeast Asia. Two other genera have migrated extensively from Australia. The six species of *Stigmatodactylus* have spread to India, Java, Celebes, and Japan; and the two species of *Codonorchis* have spread to southern Chile and Argentina.

The distribution of orchids in the North Temperate Zone is complex; nevertheless we can make certain observations in view of the current understanding of the origins of many orchid genera and their possible migratory routes. Probably as some orchid genera migrated from Asia or Africa to the North Temperate Zones, they became adapted to cooler climates. Also some of the Asiatic and African species, together with the South and Central American members, may have developed occasional "extensions" to North America. Genera of the subfamily Orchidoideae, which originated in Africa, have spread into western and eastern Europe as well as northeast Asia. Seven members of the Asiatic genera extend into the North Temperate Zone.

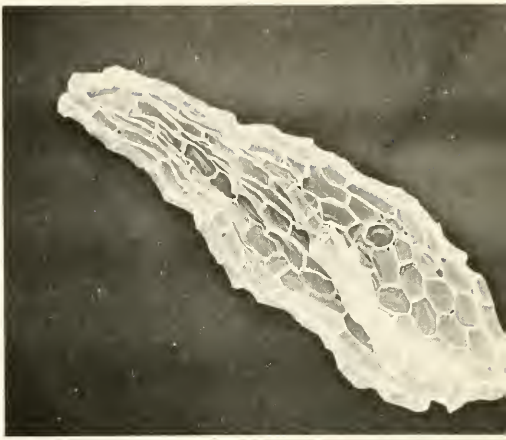
The orchid family long ago evolved its unusual method of dispersal. Unlike the oaks, with their hard-covered acorns, or tulips, with their food-rich bulbs, the orchids turn their reproductive energies into producing great quantities of tiny, fragile seeds.

Like a gambler trying to cover every possible bet, the orchid family each year casts billions of seeds into the biosphere. Most of these fail to germinate; but each year enough millions of the seeds find a pathway to the right combination of habitat and fungus to maintain, in all its wondrous and beautiful diversity, one of the most successful plant families on earth. ☐

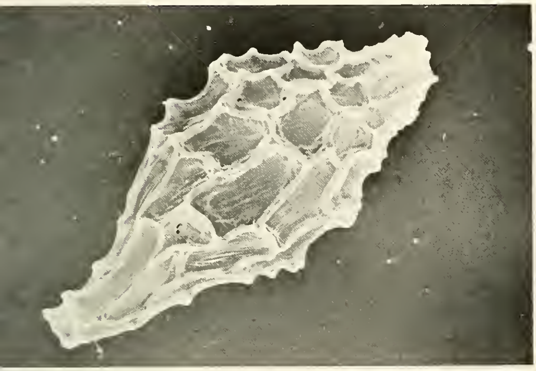
SCANNING ELECTRON PHOTOMICROGRAPHS OF ORCHID SEEDS BY EDWARD S. AYENSU



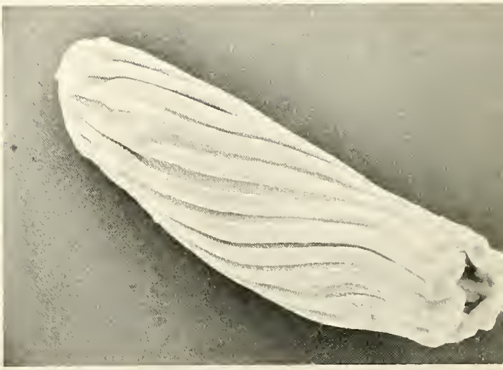
Polystachya laxiflora ×300



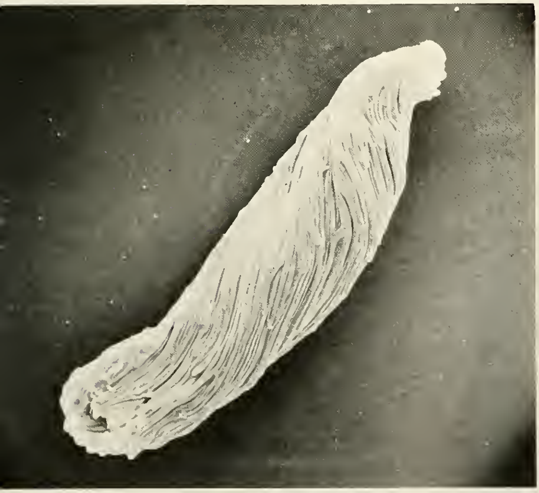
Liparis nervosa ×200



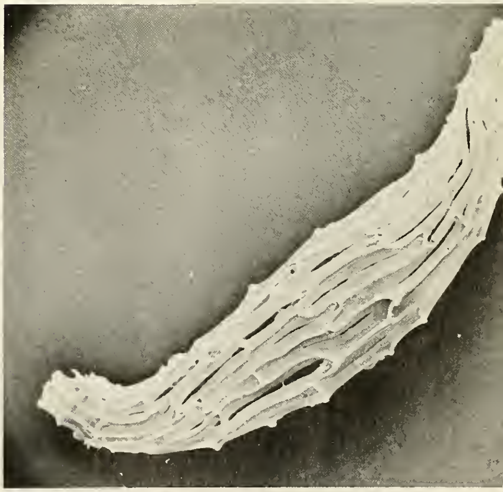
Graphorkis lurida ×200



Bulbophyllum barbigarium ×500



Diaphananthe fragrantissima ×250



Ansellia africana ×125

Song of the Bunting

Securing a territory, attracting a mate, and avoiding conflict with other birds can all be accomplished with a limited vocal repertoire

by William L. Thompson and Kenneth A. Shiovitz

The English language contains about fifty distinct sounds. Of these, few have any meaning as separate entities. Put some of them together, however, and you can have "ice cream," "empathy," or "indigo buntings." You might also have "crei ceam," "pathyem," and "godiin stingbun." The second group of sounds would not be familiar as spoken English, but one could recognize that it was a human being speaking, what sex that person was, and his or her spatial relationship to the listener. These bits of information are conveyed by means of the paralinguistic features of voice quality, relative pitch, loudness, and the directional characteristics of sound waves. Aside from this general information, jumbled sounds do not relay a clear message because of their unfamiliar arrangement. These examples illustrate two factors that, together, allow the human auditory communication system to work: a set of common sounds and a set of common rules to regulate their organization. Both factors have recently been found to exist in the vocalizations of the indigo bunting.

The indigo bunting is a small, sparrow-sized bird, whose breeding range covers roughly the eastern half of the United States. Males are bright blue, or indigo, in the breeding season, becoming browner in the autumn, while females are brown throughout the year.

In birds such as the bunting we can distinguish two different types of vocalizations. One, which we have investigated intensively, is called the song—an elaborate, usually rhythmic utterance. The second type is referred to as a call. Calls are short sounds that include the tweets and cheeps of many birds. They often differ from song in the way they develop in the young bird, as well as in their simpler form. For example, a young indigo bunting must hear the song of its own species early in its life in order to sing a normal song. On the other hand, calls of this species will develop normally even if the bird never hears adult individuals of its own kind. Each call usually conveys a rather limited message. There are bunting calls that have such human approximations as "food," "feed me," "sex?" "sex!" "look out!" and "scram!"

During the breeding season the male indigo bunting can be heard singing from conspicuous song posts on his territory. Each song lasts two or three seconds with a pause of about ten seconds in-between. Males usually sing one characteristic song over and over, and with such consistency that an individual can often be recognized. One banded bird was observed singing a remarkably stable song for four years.

Melodic and rhythmic characteristics of these songs are produced by changes in sound frequency and some regularity of silent periods between sounds. Frequency changes take place rapidly, with high and low frequencies alternating throughout. These modulated sounds are organized into recognizable units, called figures. They are often continuous sounds, but they may be divided by periods of silence lasting a few hundredths of a second. Most of the figures are repeated at least once in almost identical form. When several songs of a single bird are compared, it is found that figures are reproduced again and again with remarkable consistency. The songs of different males, however, may contain figures that seem completely different from one another. Judging from the large frequency range that these sounds cover and the rapid frequency changes that a bird can make, one might expect an almost unlimited number of figures to be present in a large population of indigo buntings. We discovered that this is not the case.

From 1965 to 1967 the songs of more than eighty individual indigo buntings in southeastern Michigan were recorded. After measuring the duration, frequency ranges, and various other parameters of hundreds of bunting figures, we found that a number of figures from different birds looked almost identical. In fact some figures were found in more than twenty different songs, with an unmistakable consistency of form. Most songs contained from three to ten different kinds of figures, but in the 165 birds that we have recorded to date, only 128 different kinds of figures were identified—indicating a high degree of "figure sharing" in the species.

To determine how significant figure sharing is in a local population of indigo buntings, thirty-nine males were recorded at the Edwin S. George Reserve near Pinckney,

Feeding her young at a nest site she chose, this female indigo bunting was first attracted to the area by the songs of her mate.

F.J. ALSOP III; BRUCE COLEMAN, INC.

RON AUSTING; BRUCE COLEMAN, INC.

Michigan, in 1965. The results confirmed that the number of figures present in a population is limited. Another sampling in 1967 revealed that there was a high degree of continuity in the use of the same figures from year to year.

We then tried to determine whether a limit to the number of figure types also existed for the species as a whole. It was possible that local populations might develop their own dialect, and that figure similarities might decline with increasing geographical separation. This had already been shown to be the case in white-crowned sparrows in coastal California. Song recordings of indigos from New York, Ohio, Nebraska, and Kentucky were obtained for comparison with the Pinckney population. As expected, some unique figures were found in each of these populations; but more than 90 percent of all the figures from these other states were present in the Pinckney population. We concluded that indigo figures are extremely stable on a temporal and geographic basis, and that the species as a whole utilizes a limited set of song figures.

To evaluate the significance of such a limited group of sound patterns, we must consider the function of bird song in general. In strongly territorial birds such as the indigo bunting, song is the main mechanism for securing and defending an ample breeding area. The possessor of a prime territory is normally assured of enough food for his mate and offspring and plenty of nesting and hiding places. When population density is high, only the strongest males are able to retain a suitable piece of land. The weakest birds do not breed or are forced to nest on poor or marginal territories. To achieve this distribution, the species wastes very few lives in direct combat. Instead, strength is tested by singing, and many vocal (and visual) displays intervene between threat and actual attack. By singing, a territorial bird communicates several things at once: avian equivalents of "I am a male indigo bunting," "I am in breeding condition," "This is my territory," "I am tough," and "Get out!" The whole song conveys all these different messages. There is no evidence that some parts of the regular song have different meanings than others. No specific figures have specific meanings comparable to the words in a sentence in human language.

Male indigo buntings broadcast their territorial claims and breeding condition via a limited but stable set of song figures.

In many territorial birds singing begins early in the spring. At this time male indigo buntings suddenly appear in suitable habitat within their breeding range, having returned from a winter spent in Central America. These early arrivals are the older, experienced males, and they have the first opportunity to occupy the prime territories. When the females arrive soon afterward, they may be guided by the male's song to a suitable nesting habitat and a mate.

On the other hand, females probably do not base their choice of mate solely upon the attractiveness of his song. Song may guide the female to a territory, but the intuitive choice to remain there probably depends upon the over-all potential for successful breeding within the territory. Females have been observed inspecting every potential nest site in a territory before deserting it a few days later if nothing suitable is available. This often happens with first-year males, who are typically forced to occupy marginal habitat. These birds seldom attract mates (although they sing as vociferously as older males) probably because of poor landholdings.

The question, then, is whether any of these functions of song are enhanced by a stable, limited set of song figures. Recognition of songs between different species could be an important factor in the evolution of the figures. The indigo bunting has several relatives, including the lazuli bunting and the painted bunting, whose songs are rather similar. Several other bird species, such as the American goldfinch and

the yellow warbler occupy about the same habitat and range as the indigo bunting; humans easily confuse the songs of these species with that of the indigo.

Working within the territorial boundaries of a number of male indigo buntings, we used a tape recorder to test species recognition of song. When the territory owner began to sing, we played a recording of a lazuli bunting or a painted bunting. Male indigos did not respond to the songs of either of these species, even when a dummy of a male indigo was placed next to the tape recorder. The playing of an indigo bunting song, however, usually brought an immediate response. It was clear from these tests that a male indigo bunting can readily distinguish songs of other species from those of its own kind.

The role of the song figures in intraspecific recognition was then examined. We were able to create experimental songs composed of new figures by playing a normal indigo song backwards. When this is done, the detailed forms of the figures are changed without altering frequency ranges or gross temporal features. If species recognition were limited to normal figure types alone, the new backward figures should elicit no positive response from male indigos. In fact, however, they gave almost a full response to the backward song. The conclusion was that a wide range of figure shapes is capable of evoking positive response.

It seems likely, therefore, that a specific configuration is not essential for intraspecific recognition, but it is also clear that song figures must conform to a particular frequency range, must be within narrow limits of duration, and must be spaced at particular intervals. It may also be necessary for the figures to contain certain subpatterns of frequency change.

A student in our laboratory, John Rice, studied the development of song in the indigo bunting. He found that males kept in sound isolation would develop songs containing figures that had never been found in wild birds. Although these figures appeared "indigolike," they were distorted in both duration and frequency range. We can conclude from this study and from field observations that indigo buntings copy their song figures from other buntings they hear singing. The studies of isolated birds show that the male indigo is capable of singing many more types of song figures than he usually does.

There is evidence that new figures may arise in a population from preexisting ones through a slow process of change and selection. The figures seem to show the same kind of variation from individual to individual as such morphological characteristics as body size and plumage pattern. This variety of figure types is probably a valuable adaptation for survival. If every bird in the species sang only a few types of figures, species recognition would be simple; but in dense woods or underbrush a female might have difficulty recognizing her mate's song, and one male might not be able to distinguish a singing neighbor from a stranger. There is evidence that individual recognition by song figures does take place. Tape-playback experiments with several species of birds have demonstrated that male birds respond more vigorously to a stranger's song than to either their own or a neighbor's song.

Another possible means of communication is the intensity of singing. Intensity changes in human speech, for example, when we are angry or upset, include variations of loudness, differences in accent, or changes in the spacing of sounds. Some of these factors have been observed in the indigo bunting during intense territorial disputes. Drastic changes in loudness of song are sometimes heard when a bird that has been singing in the low underbrush is suddenly challenged. Noticeable increases in the length of the songs and in the number of songs per bout are also heard during territorial encounters. It is quite probable that high-frequency song components are especially intimidating.

Singing provides many avenues of information transfer. Variation can occur at the level of the figure, the song, the bout of singing, the emitted sound itself, the silence between sounds, or in combinations of sound and silence. Different species can therefore exploit different aspects of song to fit their specific communication needs. For example, while indigo bunting males generally do not vary their song patterns, painted bunting males usually sing two or three different songs, and catbirds can sing more than 170 different song phrases.

The ecological significance of individual song variation seems to be the avoidance of the confusion that might result if all species in a community used the same songs. Likewise, the indigo's conservatism in song figure variation, which limits the number of figure types employed by the species, seems to enhance species recognition by decreasing the number of figure patterns to which the bird must respond. For any given species there must be a dynamic balance between the need for song stability and conservatism, leading to clear-cut species recognition, and song variation, leading to individual recognition.

Besides giving us information about the communication system of the indigo bunting and its role in this species' repertoire of survival mechanisms, research of this sort shows promise of further significance in broader areas of animal behavior study. By examining a visual record of a complex behavior pattern such as song or the temporal organization of singing behavior, we can measure actions that last only several hundredths of a second or less. Here we approach an area, still largely unexplored, between gross behavior and neural conduction. Studies of behavior at this level will help us to understand more of the physiological basis of all behavior. Bird song may soon communicate more to us than it does to the birds themselves. ☐

A female may respond to the song of a male, but if no suitable nest site is available in his territory she will desert the area.

PETER MUHLENBERG; NATIONAL AUDUBON SOCIETY

The Sharecropper's Plague

Behind the misery of pellagra is a history of corn-filled diets, ill-stocked commissaries, and families tied to one-crop farming

An unfortunate attribute of humans is their capacity to induce disease. Man-made diseases include food poisoning, alcoholism, drug addiction, toxic reactions to industrial chemicals and medications, radiation injury, and nutritional deficiencies. In the eighteenth century, sailors suffered from scurvy because they had no access to the fresh fruits and vegetables that could have provided them with the necessary vitamin C. Rickets, or vitamin D deficiency, was rampant in slum children of the nineteenth century because they had no chance to play in the sun. Pellagra, traditionally a disease of corn eaters, came about because of the contract system between those who owned land and those who worked on it.

Pellagra was first observed in the eighteenth century by a Spanish physician, Gaspar Casal, who found it was a common cause of ill health and early death among the poor inhabitants of the Asturias. His description of the disease, then termed *mal de la rosa,* was published posthumously in 1762. A few years later the same condition was described in north Italian peasants, and by the beginning of the nineteenth century, pellagra had appeared throughout Europe, causing physical deterioration, psychosis, and death to thousands of poor people in Spain, Italy, southwestern France, Austria, Rumania, and the countries of the Turkish empire. Pellagra was also recognized in Egypt and South Africa, and in the first decade of the twentieth century it became a scourge in the southern United States.

The pellagrins—those who are afflicted with the disease—have an insidious, chronic, and potentially fatal illness. Physicians have usually divided the course of the disease into four stages. The first is marked by vague symptoms, including headache, malaise, neck pains, dizziness, weakness, particularly of the legs, and hypersensitivity to touch. In the second stage, the skin becomes sensitive to sunlight; exposure to the sun results in redness of the skin followed by chronic dermatitis of the exposed portion. Although the majority of skin changes follow light exposure, pellagrins also develop skin lesions after certain other kinds of injury, such as exposure to excessive heat from stoves. Soreness of the tongue and mouth, accompanied by great thirst, may develop early in the disease or may be coincident with the second stage.

The third stage is characterized by the appearance of severe disturbances of the central nervous system. The patient experiences abnormal burning sensations of the hands, abdomen, shoulders, arms, and feet and suffers from an almost constant headache. But the most prominent symptoms are psychical, including profound melancholia. It is not unusual for the patient to have delusions of persecution or sin. Some pellagrins show suicidal tendencies. Refusal to eat is a serious complication and in a debilitated patient may lead to starvation. The last stage is one of wasting, with increasing weight loss, diminishing strength, and a tendency to succumb to intercurrent disease such as infection.

In a northern temperate climate the first symptoms usually develop early in the year. The second stage appears as the season advances and there is more sunlight. These symptoms, particularly the dermatitis from light exposure, last about three to four months, during which time the skin becomes darker over the affected parts. Then the condition recedes and the pellagrin appears to recover. During succeeding springs, however, the disease reappears with increasing severity, so that the patient passes gradually into the later phases. Wherever endemic pellagra occurs, mortality is related to prolonged nutritional deprivation.

From the time of Casal, physicians have noticed that the people who develop pellagra subsist on certain limited foods. Casal described how the poor laborers in the Asturias lived on a diet of maize varied only by the addition of turnips, chestnuts, cabbages, and apples. Casal also noted that the disease could be effectively treated by expanding this diet. In Italy the pellagrins subsisted on polenta, a kind of baked cornmeal porridge flavored with salt, butter, and cheese. Fruits and vegetables were eaten only when available at little or no cost.

In France pellagra was first seen in the Bassin d'Arcachon area. Jean Hameau, the first physician to describe pellagra in that area of the Landes, remarked that "this disease attacks individuals of both sexes and all ages, but I have not yet seen it in any but the poor and uncleanly who subsist on coarse food." This was written in 1829 at a time of local economic depression. The Landes was a marshy area, un-by Daphne A. Roe

claimed from the depredations of the sea. The local peasants lived on an almost exclusively cereal diet, based on maize. In 1846 Lalesque wrote of the Landais that their food consisted of cornmeal boiled with salt and water (*cruchade*), some rye bread, *mousset* (fried ham fat), and soup made with a little bread, onion, rancid fat, and vinegar. Occasionally, this diet was varied by the addition of salted sardines. Wherever endemic pellagra has occurred, the afflicted have subsisted for long periods of time on a diet based either on maize or, less commonly, millet.

The association between pellagra and a diet containing a large proportion of corn was one that many physicians began to perceive in the eighteenth century. It was elaborated in the nineteenth century, but conflicting theories also appeared. Some believed that the disease was caused only by the consumption of moldy corn, while others held that it was due to an inherited susceptibility, an infection, or excessive exposure to sunlight. Théophile Roussel, a French physician writing in 1845, held that pellagra was due to the consumption of moldy corn, but he acknowledged that the disease was hardly ever seen in those who had a mixed diet containing adequate amounts of meat or other sources of animal protein. He also noted that the disease was rare in those for whom wheat or rye bread was a major part of their food intake.

In 1916 the American physician Joseph Goldberger and his colleagues in the U.S. Public Health Service made an extensive study of the diet of pellagrous and nonpellagrous households in textile mill communities in South Carolina. Most of the people they studied lived on the traditional southern diet of corn, fatback, and molasses: The members of pellagrous households ate almost no fresh meat or eggs; but among those households that consumed a certain amount of meat and eggs, as well as milk and cheese, pellagra was rare or absent.

The striking similarity in the diets of pellagrins in the different countries in which the disease has occurred is of particular interest. It is much more significant that these people had little or no intake of fresh meats and cereals such as wheat than that they based their diet on corn. A series of studies initiated by Goldberger led to the discovery by Conrad Elvehjem that pellagra is the result of a deficiency of niacin, or nicotinic acid, a B complex vitamin that is present most richly in fish, peanuts, yeast, and meats, particularly organ meats. Moderately good sources of niacin include wheat and such legumes as peas, kidney beans, soybeans, and navy beans. Further, the relative absence of meat from the diet causes not only a niacin deficiency but also a deficiency of the amino acid tryptophan, which is, in part, converted to niacin in the body. Corn is a poor source of both tryptophan and niacin, and a prolonged diet consisting almost exclusively of corn is likely to result in pellagra.

The Indian societies of Mexico and Central America seem to be the one exception to this general rule. Corn has been their traditional staple, yet within recorded times, pellagra has seldom been a significant problem. In 1869, Ismael Salas, a young Mexican physician, wrote his doctoral dissertation on this subject, explaining that the corn in his country was treated with lime, which preserved it as a nourishing food. It is now known that this age-old Mexican process of treating corn with lime somewhat enhances its nutritional qualities. This could account for the survival of Indian peoples and their relative freedom from pellagra, although their consumption of beans and coffee may be contributing factors.

Historically, the vast majority of pellagrins have been sharecroppers. In fact, it is difficult to follow the progression of endemic pellagra without understanding the theory and practice of tenant farming. The principles of tenancy go back to Roman times, when sharecropping, which is only one of the various forms of tenancy, was introduced as an alternative to slave labor. Under this system the farmer, or landlord, supplies the tenant with implements, housing, seed, and often food. In return, the tenant must perform certain work on the farm, such as producing a crop; and when the crop is harvested, he pays the farmer about half the yield. He must also repay the farmer for any food or other supplies that have been advanced to him. Arrangements between a landlord and his tenant are rarely by written contract, and the amount of the crop the tenant has to pay his landlord has varied from place to place and from time to time.

In a small book published in

1828, Count Adrien de Gasparin extolled the advantages of sharecropping. He believed that *métayage*, or sharecropping, was not a choice but, in certain circumstances, a necessity. This arrangement between landlord and tenant was necessary, he wrote, when the agricultural populations did not possess any capital. He further stated that *métayage* meant that the poor were free, no longer enslaved, and the landlord was free to carry out other, more important work than tilling his own land.

In theory, the sharecropper, or *métayer*, is assured shelter and food for himself and family without any special responsibility other than his debt to the landlord. In practice, however, these advantages may be far from realized. Under conditions of crop failure or economic depression, a hard-pressed landlord will economize on his commitments to his tenants. Even when there is no profit from the crop, the landlord may seek to gather or extort his share from the sharecropper, thus sending the latter into penury. Although sharecropping arose in many countries as an alternative to serfdom or slavery, its perpetuation has been highly influenced by crop monoculture and by local economic situations. The worse the economic status of the landlord, the more dependent he became on a single crop, and the more likely the continuance of the sharecropping system.

Tenant farming was used to maintain southern agriculture when slavery was abolished in the United States. In 1880, 30 percent of southern farms were operated by tenants; by 1920 tenancy had increased to 55 percent. And in 1930, 61.5 percent of southern cotton farms were cultivated by tenants; out of every 100 tenants, 27 were sharecroppers. Erskine Caldwell, writing in 1937, described the situation: "The sharecropping system has in recent years branched out into several forms, none of them more economically sound than the source from which they sprang, and most of them working greater hardships on human lives than the plantation system ever did. . . . It is foolish to ask a tenant farmer why he remains where he is. . . . There is cotton to be raised and he has trained himself to raise it. It is his life and if sharecropping continues as an institution, it will be his death."

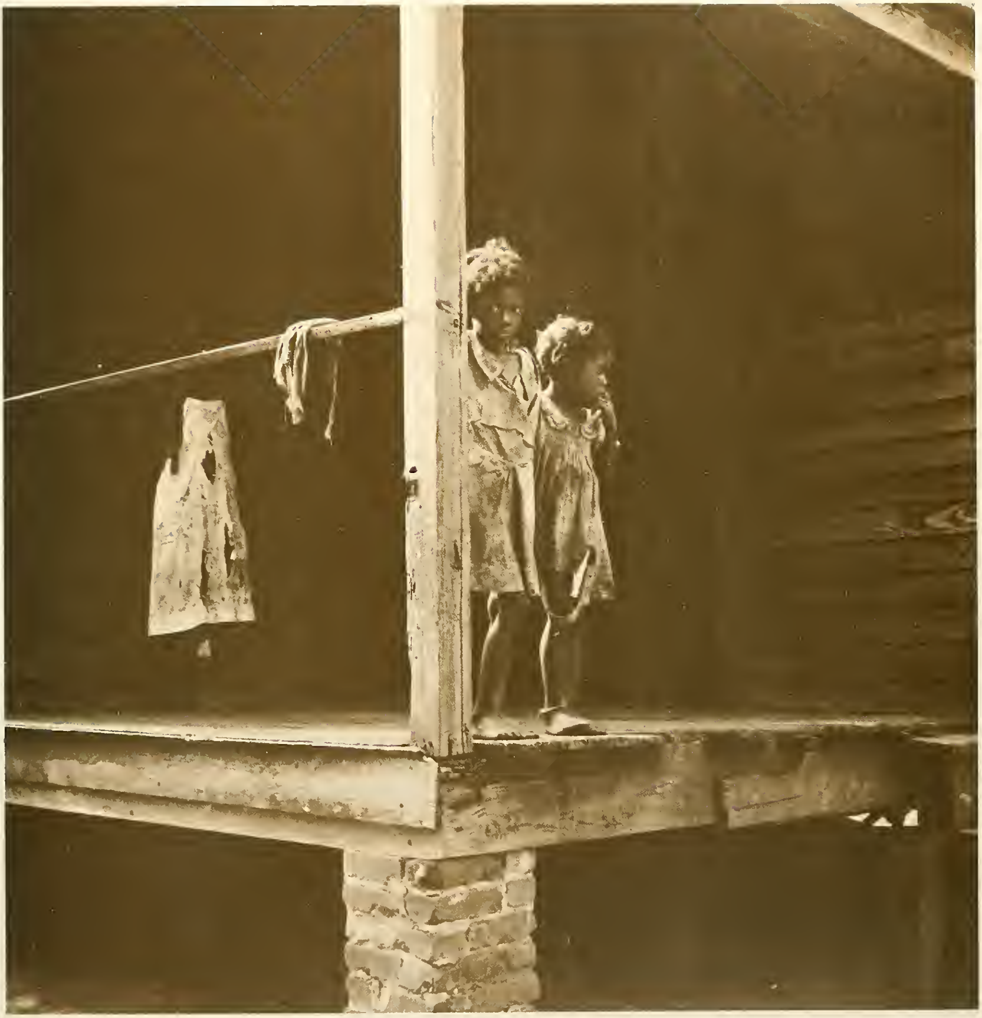
A field study of cotton tenancy in the southern states, carried out between 1933 and 1935, showed that food was the largest item in the tenant's budget. Since almost no food was grown in the cotton areas, sharecroppers had to purchase it, usually at landlord-operated commissaries. A report on this survey pointed out that since the land was devoted to a single cash crop, cotton, and since food crops mature during the same season as cotton, it was virtually impossible for tenants to raise subsistence crops.

Further, the landlords determined what should be grown, and since they did not deem it necessary to grow vegetables or other food crops, this situation of growing an entirely inedible substance continued. Because few cereals were grown and few animals raised in the cotton-growing areas, food in the commissaries was mainly imported from other places. In order to maintain a profit or simply to break even, the landlords stocked the commissaries with the cheapest foods. Except for the occasional chance to buy vegetables or eggs from an itinerant vendor, sharecroppers and other tenant farmers had access only to these commissary foods.

The credit used by sharecroppers to obtain their supplies, including food, was commonly known as "furnishing"; the landlord furnished the sharecroppers with necessities during the crop production period and the sharecroppers paid for these advances out of their share of the crop at harvesttime. The food that could be purchased in the commissaries included the notorious three Ms: meat (fatback), meal (cornmeal), and molasses. In the 1933–35 survey mentioned above, a conversation with a Negro woman is recalled: "What's the trouble, Julia, don't you feel well?" "I'm just hungry, mister. . . . I ain't got nothing but fatback and cornbread and I done eat that so long that I believe I got the pellagacy."

Before 1906, there were only a few sporadic cases of pellagra in the United States. From that time on, however, pellagra appeared and spread with frightening rapidity, mainly in the southern states, but also in the midwest, particularly in Illinois. The economist Edgar Sydenstricker showed that rising food costs in these areas coincided with the appearance of endemic pellagra. The pellagrins were chiefly sharecroppers and their families, cotton mill workers, and the in-

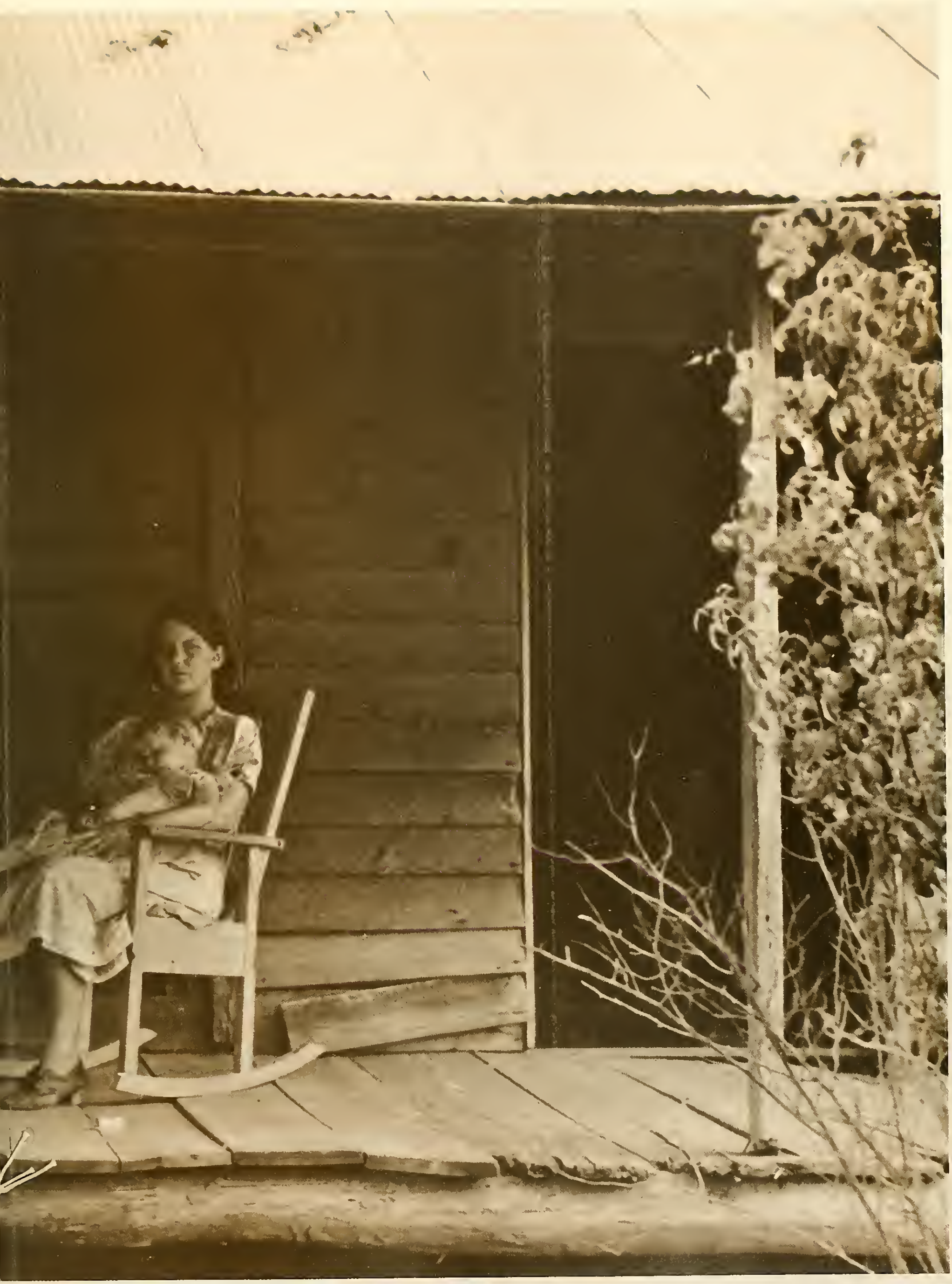
To win support for its assistance program, the Farm Security Administration hired photographers to travel throughout rural America and document the plight of the Depression-struck farmer. Many of their photographs, now part of the Library of Congress collection, portray the pervasive poverty of the sharecropper and the conditions that made pellagra endemic throughout the southern United States.



DOROTHEA LANGE

BEN SHAHN

BEN SHAHN



DOROTHEA LANGE

BEN SHAHN

ARTHUR ROTHSTEIN

ARTHUR ROTHSTEIN

mates of southern institutions such as orphanages, prisons, and mental hospitals. Many pellagrins were admitted to mental hospitals, accounting in large part for the prevalence of the disease in these institutions. Both outside and inside institutions, the single most important factor in the development of pellagra was the limited diet available and, above all, the meager supplies of meat and other niacin-rich foods.

During the United States pellagra era, that is, between 1906 and 1940, the prevalence of pellagra among sharecroppers in the southern states varied locally and from year to year. William De Kleine attributes the rise in pellagra incidence in the 1920s, before the industrial depression, to the agricultural depression that began during the early post-World War I period. Goldberger observed that an unprofitable year in cotton production was usually followed by an increase in the incidence of pellagra and pellagra mortality, and that the converse was also true. In the long run, however, the incidence of pellagra decreased when and where cotton production declined owing to economic depression, soil erosion, outdated methods of agriculture, and the ravages of the boll weevil. If, for these reasons, cotton could not be grown, the sharecroppers could turn to other occupations and grow their own food or raise farm animals, thus providing themselves with a more diversified diet. Over the years from 1930 to 1933, the depth of the Great Depression, pellagra declined in the southern states.

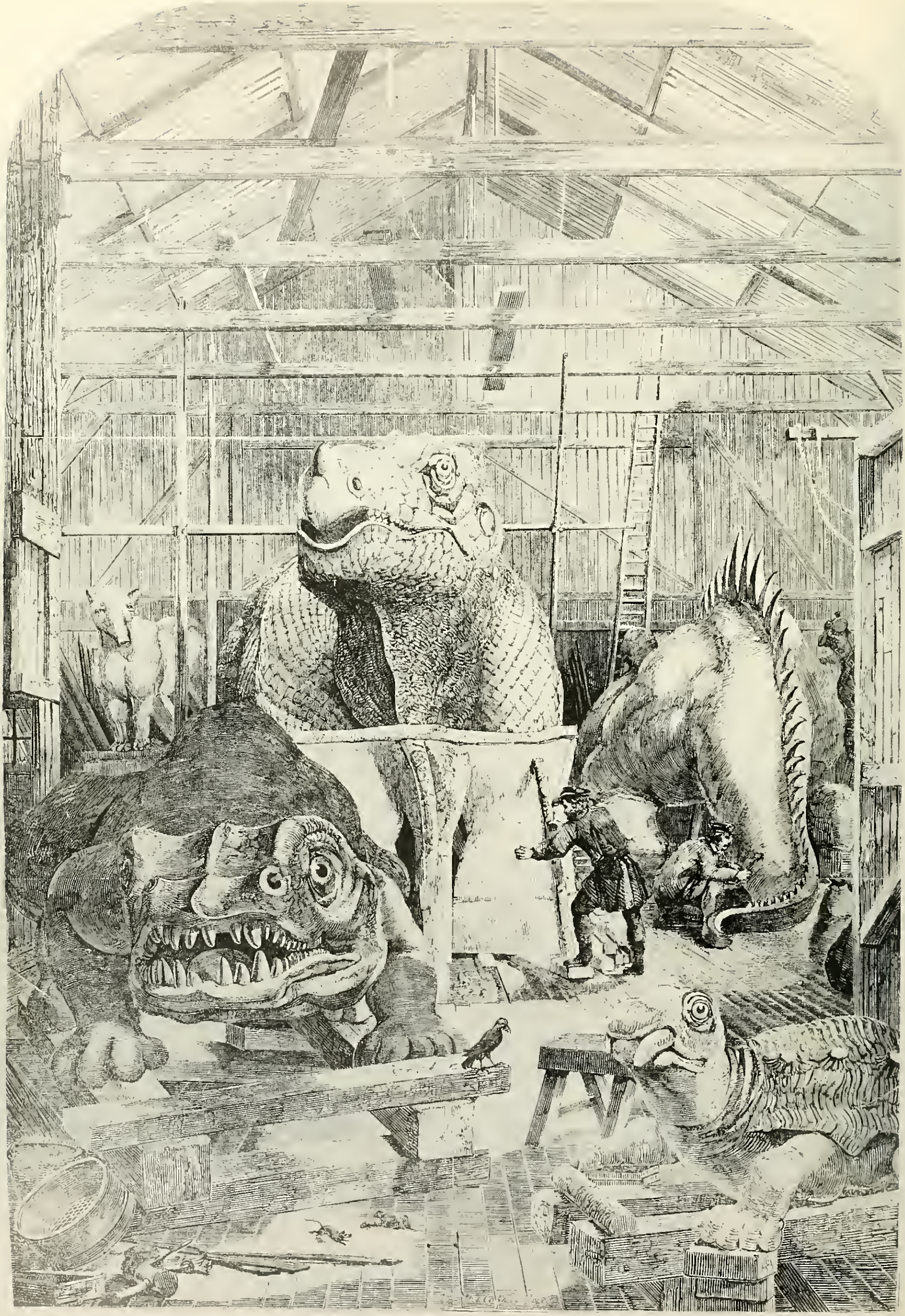
The changing incidence of pellagra during those years and in the years that followed cannot, however, be attributed entirely to the vagaries of the cotton economy. Agricultural extension service workers in the southern states, as well as Mormon missionaries, went about teaching the sharecroppers to produce garden plots and to grow such products as wheat, oats, barley, peanuts, soybeans, and field peas, as well as fruits. Raising chickens and a few larger farm animals was also encouraged. When home gardens were on the increase, that is after 1927, the American Red Cross distributed yeast to health departments and physicians in the pellagra areas. Yeast is extremely useful as a pellagra preventive, if indeed, it is consumed as intended. It was, however, useless as a treatment for victims of advanced pellagra because they could not swallow it. Between 1937 and 1938 niacin became available as the specific preventive and treatment for pellagra.

Perhaps one might naïvely have expected the disease to have disappeared overnight, but the benefits of scientific progress were not immediately available to the cropper in his cabin. Delays in the conquest of pellagra have often been attributed to the conservatism of the sharecropper and to his poor food habits—to the assumption that he would rather have the three Ms than other foods. This is as hard to swallow as the powdered yeast was for the pellagrins. The delay in the conquest of pellagra in the southern states can best be explained by the persistence of sharecropping and by the fact that niacin was not brought to every table until 1943, when bread and other cereals were enriched with niacin and other important nutrients.

Between 1940 and 1950 sharecropping on southern farms, particularly in the cotton areas, gave way to a new plantation system that brought the introduction of agricultural machinery. The workers employed on these new and larger farms are fewer in number, and although they may receive full housing, they also get cash wages. "Furnish" is no more, and the ill-stocked commissary is a thing of the past. The old saying "Live through the winter, die in the spring" has no more meaning in the United States.

In Europe, as a result of economic, agricultural, and social development, especially the ending of the various sharecropping systems, pellagra has also been virtually wiped out. In northern Italy, for example, since the tenant farmers gained their independence, they have produced their own food and need no longer rely on the distribution of low-grade maize to make polenta. But it is not yet the time to be smug. Pellagra remains a major health problem among the Bantu in South Africa, and it is still prevalent in Egypt and in the Deccan Plateau region of India. In these countries the disease continues to affect the rural poor, who, whether they subsist on maize or millet, cannot afford such pellagra-preventing foods as eggs and meat.

The story of the "plague of corn" is not yet a completed chapter in the chronicle of medical history. While anyone can cure pellagra with a handful of pills, social progress is hardly measurable if the disease still makes its appearance in the same conditions of misery that have been its background since the first cases were seen among Spanish peasants. □



ILLUSTRATED LONDON NEWS

Central Park's Fragile Dinosaurs

With a shattering blow, Boss Tweed and his Ring put an end to the revival of prehistoric reptiles and mammals in New York City

by Adrian J. Desmond

"Potentates of the Wealdon and Oolite! Saurians and Pterodactyles all! dreamed ye ever, in your ancient festivities, of a race to come . . . dining on your ghosts, called up from the deep by their sorcerers?"

Such was the response of the London *Quarterly Review* in 1854 to the conclave of Victorian scientists dining *inside* the first life-sized restoration of a dinosaur. The event marked the successful completion of a unique enterprise. The dinosaur's creator, the painter and sculptor Benjamin Waterhouse Hawkins, described it in the grandiose phraseology of the day as the "revivifying of the ancient world," summoning "from the abyss of time and from the depths of the earth, those vast forms and gigantic beasts which the Almighty Creator designed with fitness to inhabit and precede us in possession of this part of the earth called Great Britain."

The resurrection of the extinct reptiles and mammals was primarily an educational venture, and Hawkins, who took his role as a "visual educator" seriously, set about the Herculean task of reconstruction with almost religious zeal. The experience would serve him well when he attempted a similar enterprise in New York some years later.

The dinosaur restorations owed their existence to London's Great Exhibition of 1851, a new type of fair designed to celebrate Britain's technological prowess. The first iron-framed, glass-curtain building in the world—the Crystal Palace—was constructed in Hyde Park to house the exhibits.

After the exhibition closed in 1852, the Crystal Palace was dismantled and re-erected in the London suburb of Sydenham as a permanent showcase for the arts and sciences. Upon the suggestion of Queen Victoria's consort, Prince Albert, paleontology was to be included among the exhibits in the reconstructed Palace.

Hawkins originally undertook the building of giant mammals, such as the mastodon, for the Crystal Palace Company. Then, in the writings of the English anatomist Richard Owen, Hawkins learned about dinosaurs. (Owen actually coined the word Dinosauria, from the Greek "terrible lizard," in 1841.)

Not put off by the lack of fossil bones, Hawkins began planning the first full-scale models of these beasts. He submitted his designs to Owen for criticism, and the two worked closely until the scaled-down sketch models met Owen's rigorous specifications. Hawkins then built life-sized clay models, some weighing as much as thirty tons; from molds of these models, he took casts, which he filled with an assortment of building materials. An inventory of materials used in one 35-foot-long *Iguanodon* emphasizes the beast's size:

- 4 iron columns, 9 feet long by 7 inches in diameter
- 600 bricks
- 650 five-inch, half-round drain tiles
- 900 plain tiles
- 38 casks of cement
- 98 casks of broken stone
- 100 feet of iron hooping

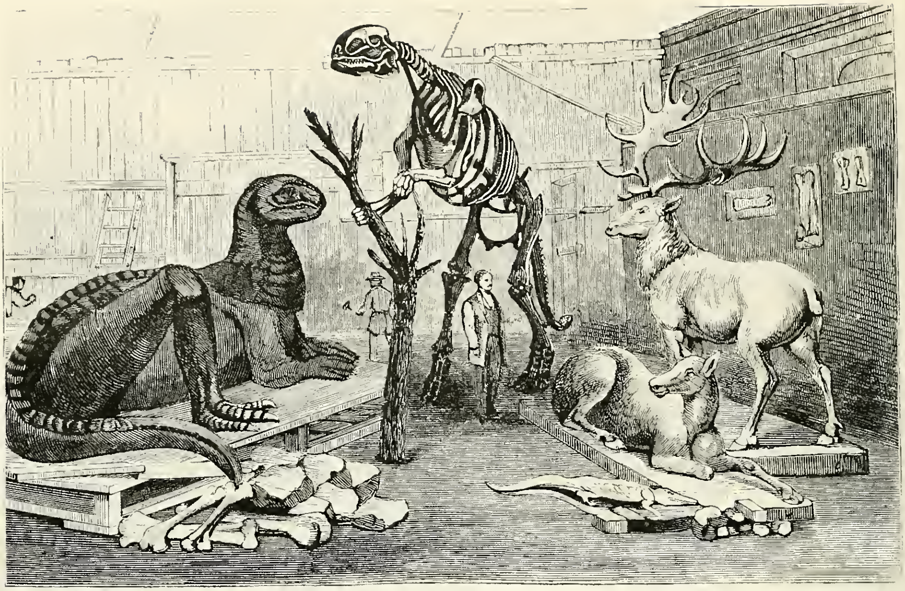
Twenty feet of solid iron bar completed the "bones, sinews, and muscles of this large model."

To separate the finished reptiles from the public, they were placed on islands in a six-acre lake, artificially created on the extensive Palace grounds. The islands were landscaped with real vegetation, as well as with replicas of plants of the Cretaceous period such as palm ferns, also known as "petrified pineapples" because of their strange trunk ornamentation. To enhance the illusion, the water in the lake would rise and fall like an actual tide, partially submerging the creatures at intervals.

Ominous warnings began to appear in the press. "Huge Chelonians are to bask upon its banks," announced the *Illustrated London News*, while "the Brobdignagian grandfather of turtles, gaping, shall frighten aldermen with ideas of retribution in its monstrous jaws."

The reptiles were arranged on

The Iguanodon *model, center, was nearly finished in 1853 when Queen Victoria and Prince Albert visited Benjamin Waterhouse Hawkins's Crystal Palace studio.*



HARPER'S WEEKLY, 1868

Hawkins is dwarfed by the skeletal form of Hadrosaurus *in his Central Park studio.*

the islands in the order of their supposed appearance on British soil between 200 million and 70 million years ago. The archaic Triassic period reptiles guarded one end of the island chain, and the more recent Cretaceous period dinosaurs, *Iguanodon* and *Hylaeosaurus*, and the pterodactyls guarded the other end. The marine saurians and carnivorous *Megalosaurus* of the Jurassic were placed in the middle.

Upon completion of the restorations the dinner was held inside one of the *Iguanodons*. The invitations, "written on the wing of a Pterodactyle, spread before a most graphic etching of the *Iguanodon*," read, "Mr. B. Waterhouse Hawkins solicits the honour of Professor ––––'s company at dinner, *in the Iguanodon*, on the 31st of December, 1853, at four P.M."

Twenty-one guests occupied the reptile's socially loaded stomach, with Professor Owen sitting at the head (literally). The director of the park toasted the queen and her consort, Prince Albert; Owen toasted Hawkins for the accuracy of his reconstructions; and the geologist Edward Forbes toasted the successful blend of art and science.

The party of eminent scientists consumed so much drink that, as the evening progressed, boisterous shouts could be heard across the entire park. By midnight the group was singing in chorus to Forbes's poem:

> The jolly old beast
> Is not deceased,
> There's life in him again.

But perhaps the last word on this world of scientific gastronomy should go to *Punch*, which congratulated "the company on the era in which they live; for if it had been an early geological period, they might perhaps have occupied the *Iguanodon*'s inside without having had any dinner there."

Today the freshly painted beasts present a spectacular sight to people chancing upon them in Crystal Palace Park. The Palace itself was completely destroyed by fire in 1936—a tragedy that may explain why the dinosaurs are so little known. Casual visitors are puzzled by the models since there are few indications of their origin.

Yet, to a critical eye, the models embody many of the misconceptions current in the early nineteenth century. The *Iguanodon*, posed on four feet, actually walked on two. The ichthyosaurs and plesiosaurs crawl onto the shore because Owen thought that they liked to bask in the sun. In fact, they lived in open water. Perhaps the most famous error is the supposed horn on the *Iguanodon*'s nose. It actually was a part of the animal's thumb.

Posed on one of the islands, the pterodactyls look suspiciously like dragons. Indeed, Hawkins claimed that the pterodactyl was the prototype of the mythical dragon. The first three fingers on its forelimb were used for grasping, the fourth was tremendously elongated to form the principal support for a wing membrane. Thus, like a dragon, the pterodactyl appeared to have wings *in addition* to its other limbs. The pterodactyl was more of a hybrid than even Hawkins realized: paleontologists now believe it was warm blooded and had a coat of fur like a mammal.

On June 10, 1854, forty thousand spectators watched as Queen Victoria and Prince Albert reopened the Crystal Palace. The Owens were there, as were the Darwins. Not until after the publication of Darwin's *Origin of Species*, in 1859, was the theory of evolution generally accepted by scientists. But in 1854, when the giant reptiles made their debut at the Crystal Palace, they were still considered by most people to be relics of a former creation—antediluvian monsters, some of God's earlier creations that perished in Noah's Flood. This view was shared by many eminent scientists of the day, including Owen, who referred to modern-day animals as members of the "present creation."

"What *are* those?" exclaimed a traveler in a railway carriage as it passed the Palace grounds. A fellow passenger informed him that they were antediluvian monsters.

"Why antediluvian?" inquired the traveler.

"Because they were too large to go into the ark; and so they were all drowned," the passenger answered.

The controversy continued in the learned journals. The *Quarterly Review* of 1854 thought that the reptiles in the "mausoleum of the memory of ruined world" elevated our minds "upward toward the Creator's past eternity," while the rival *Westminster Review* ridiculed talk of antediluvian creatures, but conceded it was better to view them "with an untenable theory than with no theory whatever!"

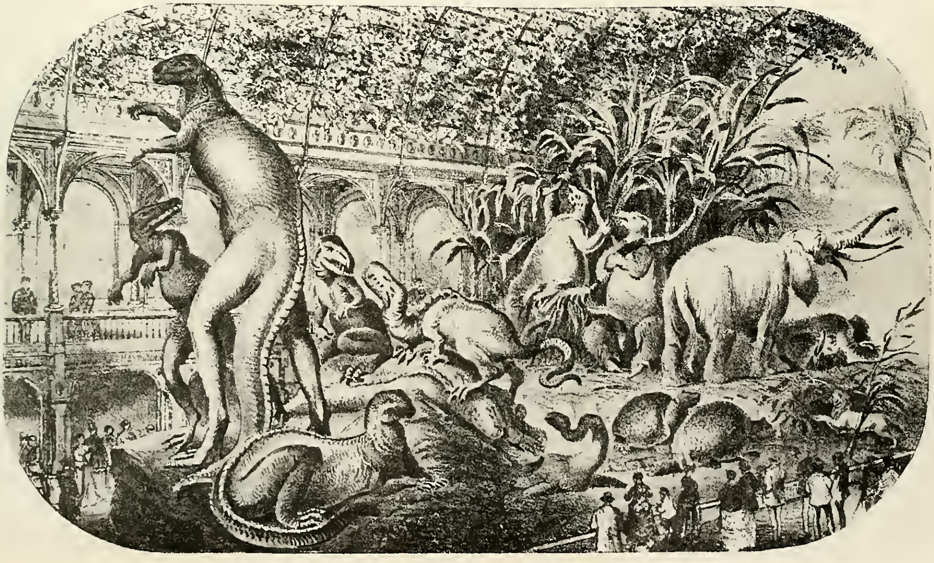
Spectators flocked to the Palace and its grounds, many spurred on, no doubt, by the prospect of viewing the monsters that inhabited the earth before Noah. Within months, whole rows of teeth had disappeared from the models, leading a contemporary writer to conclude that in their enthusiasm the "culprits supposed they were carrying away the real teeth of preserved animals." This, he added, was the reason for the "need of educational exhibitions like this." By the end of the century, however, the models—dilapidated and unlabeled—were thought by the public to be either "inferior imitations, on a large scale, of certain animals at the Zoological Gardens" or "creations of some eccentric person's imagination."

Some of the creatures are strange hybrids, indeed. In the case of the oldest reptiles, Hawkins had only the skulls to work with and had to use his ingenuity in making the bodies. The *Dicynodon* was a Triassic reptile with walruslike tusks—a cousin of the reptiles that evolved into mammals. But the fossil skull had a horny beak, which misled Hawkins into reconstructing a huge tusked tortoise. And he made the *Labyrinthodon*, a crocodile-shaped creature in life, into the likeness of a giant frog because it was an amphibian.

Unaware of the inaccuracy of his creations, Hawkins later styled himself on the title pages of his books on anatomical illustration as "Restorer of the External Forms of the Extinct Animals at the Crystal Palace Park."

By the 1860s the fame of the

A foliaged arch sheltered Hawkins's animals in his sketch of the planned Central Park paleozoic museum.



ANNUAL REPORT OF THE CENTRAL PARK BOARD OF COMMISSIONERS, 1868

Crystal Palace reconstructions had spread across the Atlantic. In New York, the Board of Commissioners of Central Park (forerunner of the present-day Parks Department) were aware of the success of the Crystal Palace venture. They too saw the educational value of such an enterprise. Andrew Green, the able Board administrator, observed in 1868 that "although the Sydenham Park is situated several miles from the metropolis, and notwithstanding that there is a charge for admission, yet hundreds of thousands of people have visited it annually for the last fifteen years, while the animal restorations have been a permanent element of attraction, and a source of valuable instruction to multitudes who would have gained this kind of knowledge in no other way."

Green believed that the role of education was that of "object teaching." He was a driving force behind the founding of the Central Park Zoo and, in 1869, of The American Museum of Natural History.

In May, 1868, Green approached Hawkins, who had moved to New York, with a request "to undertake the resuscitation of a group of animals of the former periods of the American continent." Hawkins unhesitatingly accepted the offer and immediately set to work, traveling to museums in Washington, New Brunswick, Albany, and New Haven to search for fossils. In Philadelphia, he discovered what he was looking for.

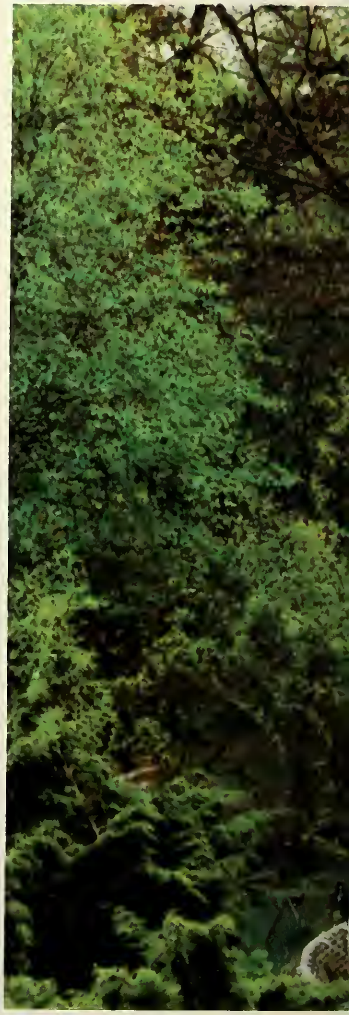
Joseph Leidy, an anatomy professor at the University of Pennsylvania and chairman of the Board of Curators of the Philadelphia Academy of Natural Sciences, had told the Academy in 1858 of the first dinosaur bones found in the United States. This huge herbivorous relative of the European *Iguanodon* had been found by William Foulke at Haddonfield, New Jersey, and Leidy had named it *Hadrosaurus foulki* after its discoverer. He noted at the Academy's meeting that "a very great disproportion exists between the bones of the fore and hinder extremities." This is the first intimation that "this great herbivorous lizard may have been in the habit of browsing, sustaining itself, kangaroolike, in an erect position on its back extremities and tail." Leidy's suspicion that some dinosaurs were bipedal came only four years after the London restorations. In fact, all the carnivorous dinosaurs and such herbivorous ones as *Hadrosaurus* and *Iguanodon* walked on their hind legs.

Only eight years later, in 1866, Edward Cope announced to the same Academy another first—the bones of a carnivorous dinosaur found in the Cretaceous rocks of New Jersey. Cope named the dinosaur *Laelaps*, and in the Victorian tradition of viewing life in preceding ages as a bloody struggle for survival, he said it preyed upon the herbivore *Hadrosaurus*—a belief readily adopted by Hawkins for his proposed restorations.

Cope realized that the short forelimbs indicated that this dinosaur was also bipedal. But, if so, how could it have caught and killed its prey? Thinking that the feeble forelimbs would have been useless, he believed that it chased and stabbed the *Hadrosaurus* with its hind limbs. The chase Cope envisaged would have been a strange sight—two forty-foot-long monsters leaping along like kangaroos.

While at Philadelphia, Hawkins's attention was drawn to a forty-foot fossil marine reptile that had been sent to the museum from Kansas. Postponing his drawings of *Laelaps* and *Hadrosaurus*, he concentrated on this new find. The creature was the long-necked plesiosaur *Elasmosaurus* described earlier by Cope.

From September until December, 1868, Hawkins took molds of the bones of *Hadrosaurus*, *Laelaps*, and *Elasmosaurus* and made plaster models of missing bones. In exchange for the facilities provided at Philadelphia, he presented the Academy with a restored skeleton of *Hadrosaurus*, which remained on exhibition for many years. In December he returned to New York and commenced the work of restoration in the paleontological studio in Central Park. There he began to build two *Hadrosaurus* models, one twenty-six feet long and more than thirteen feet high; the other, thirty-nine feet long. When completed, the former reclined in a sphinxlike pose with huge hind limbs and smaller forelimbs. The larger *Hadrosaurus*, which probably never



Today two Iguanodons *guard an island in Crystal Palace Park. In 1853 scientists attended a banquet inside the one in the background.*

passed the skeletal stage of restoration, stood erect on its hind limbs.

These giant reptiles were to be housed in the paleozoic museum planned for Central Park. Like the Crystal Palace building, the museum was designed as a huge, iron-framed glass building with an arched roof. In Hawkins's illustration of the interior of the proposed museum, the larger *Hadrosaurus* is being attacked by one of the carnivorous *Laelaps*, while two other *Laelaps* fight over an enormous corpse. At their feet the marine *Elasmosaurus* lurks in the water. From the park commissioners' *Report*, we know that Hawkins was also building a *Mosasaurus*—a giant Cretaceous marine lizard with paddles. Models of early man's more spectacular contemporaries—the mammoth, mastodon, giant sloth, giant armadillo, and giant elk—were also planned. The aim, according to the commissioners' report, was "a complete visual history of the American continent from the dawn of creation to the present time."

The extensive foundations of the paleozoic museum were laid in the southwest corner of the park opposite 63rd Street. But in 1870 disaster struck in the form of political maneuvering by William Marcy Tweed.

For several years, the Tweed Ring had been buying and bullying its way into control of four bastions of power—Tammany Hall (the local Democratic Party organization), City Hall, the state government,

ADRIAN DESMOND

ADRIAN DESMOND

A plesiosaur, foreground, and an ichthyosaur were re-created as shallow-water dwellers. Paleontologists later discovered that they lived in deep water.

and the courts. Tweed henchmen were maneuvered into all key posts: John Hoffman was governor; "Elegant" Oakey Hall was mayor; and Richard "Slippery Dick" Connolly was comptroller. "From 1866 to 1871," the historian A. B. Callow has recently said, the Tweed Ring "plundered the City of New York with such precision that it has received the singular distinction of being labeled the model of civic corruption in American municipal history." Tweed maintained an iron grip on the city legislature. Through graft and treasury plundering, he became immensely rich and the third largest real estate owner in New York.

"Boss" Tweed now cast an envious eye on Central Park. In 1870 the state legislature approved a new city charter, which abolished the old park commission and set up a new Department of Public Parks. Green stood helpless as Tweed's right-hand man, Peter "Brains" Sweeny, took control of the park. The *New York Times,* waging a bitter campaign against these unsavory politicians, prophesied the demise of Central Park.

The new administration, which took office on May 1, 1870, was from the outset hostile to the paleozoic museum. Ostensibly, financial considerations prompted their decision to halt work; the foundations alone had already required an expenditure of $30,000. The estimated final cost of the building was $300,000, which the Tweed commissioners, "deemed too great a sum to expend upon a building devoted wholly to paleontology—a science which, however interesting, is yet so imperfectly known as not to justify so great a public expense for illustrating it." Not even a plan to merge the museum with an aquarium could save it. Ironically, in their first eighteen months in office the Tweed commissioners spent $8 million of public money as patronage—providing four thousand laborers with work in the park to insure their continued support. The Green commission with all its educational schemes had spent only $250,000 a year. Yet Sweeny was unable to find $270,000 (the architect's estimate) for the museum.

The first report of the Tweed commissioners made plain their contempt for the project. They even appeared skeptical of the great antiquity of dinosaurs themselves, referring to them sarcastically as "specimens of animals *alleged* to be of the pre-Adamite period." Some months later, a Tweed adversary commented: "Professor Hawkins has been studying books and bones; what does he know about the management of Central Park; he was only an Englishman anyway, and the idea of his trying to get up a museum in this City without a corresponding scheme for dividing the profits, was an absurdity." Because the Tweed organization stood to gain no profit from the museum, the commissioners filled in the foundations. But worse was yet to come.

Hawkins continued building the models until December 1870, hoping that the Smithsonian Institution in Washington, D.C., would purchase them. By that time he had been working almost two years on the restorations, although it had taken him only eighteen months to complete twenty-two reptiles and numerous extinct mammals for the Crystal Palace. An illustration in the old commissioners' *Report* of only one corner of his studio shows that by early 1869 Hawkins had completed the smaller *Hadrosaurus* and a pair of giant elk, and had made a cast of the skeleton of the larger *Hadrosaurus.* An extant photograph of the same period shows what is probably a finished *Elasmosaurus.*

An inventory of park property made the day after the Tweed takeover states that, in addition, Hawkins had built *Laelaps* and "seven plaster casts of animals" of unspecified type. He was well on the way to his goal of twelve reptiles.

But "Professor Hawkins," as the Ring called him, was costing the Tweed organization money. The reason for the events that followed are not difficult to understand. "Boss" Tweed was not above vandalism: he had used it many times before. And there were 4,000 Tweed-supported laborers sitting idly in the park. In the spring of 1871, under orders from Ring commissioner Henry Hilton and with the blessing of "Brains" Sweeny, vandals smashed the dinosaurs with sledgehammers and carted away and buried the small pieces. Still not content, Hilton ordered the molds and sketch models destroyed, while taunting the shocked Hawkins that "he should not bother himself about dead animals, when there were so many living ones to care for."

Everything was totally destroyed. No one knew where the pieces were buried, but less than four years later the *North American Review* stated that "the fragments have since been dug up, but in a thousand pieces and utterly worthless." It was an inestimable loss to the growing science of paleontology. Hawkins was understandably shattered and never again attempted such an enterprise. He retired to Princeton University and academic seclusion for some years before returning to England.

Ironically, only a few weeks after this act of vandalism, Tweed himself was broken by another Englishman. Louis Jennings, a British editor hired by the *New York Times,* campaigned against the Ring with almost evangelical fervor. His invective and the *Times*'s exposure of the frauds perpetrated by the Ring resulted in its loss of political power and prosecution of its leaders. Tweed was convicted and served one year. Rearrested on another charge, he escaped and fled first to Cuba, then Spain. Extradited from Spain, Tweed died in prison in 1878. Sweeny fled to Canada and the Park Commission reverted back to the capable hands of Andrew Green. But the damage had been done. All that remains of Waterhouse Hawkins's labors in Central Park are a few precious drawings of dinosaurs in strange Victorian guise. ☐

Special Hunt of the Sharanahua

When meat becomes scarce, the women of a remote Peruvian Indian tribe challenge the men's masculinity by provoking them to kill game in the forest

Text and photographs by Janet Siskind

Along the upper Purus River in Peru's tropical forest, there is an hour—between five and six in the afternoon—when the gnats fade away and the mosquitoes have not yet begun to bite. The sun casts long shadows and imparts a deep yellow glint to the broad green leaves of the banana trees silhouetted against the streaked sky.

The young Sharanahua women have gathered in the clearing in front of the largest house in the village. Their faces are freshly painted with red achiote; their hair, still glistening from their baths in the river, is perfumed with a touch of hair dressing. Wearing their best cotton dresses and a few strings of beads, they wait until Tomuha comes to lead them.

Tomuha is a Culina woman from another village who married a Sharanahua several years ago. She knows how to send the men out to hunt. Several Sharanahua women have learned the Culina song that has replaced the old Sharanahua chant they used to sing. Singing in Culina is an exotic touch that seems to fit the occasion.

Earlier in the day, women from several houses had complained that there was no meat. For two or three days they had eaten only manioc, maize, and palm nuts. The children were screaming for meat, but the men were lazy. The women decided it was time to send the men out, to start a special hunt instead of depending upon the whim of each man or the goading of each woman.

After the feast, the games begin. In this one, the women try to retrieve a piece of sugar cane from the men.

As the shadows lengthen, the women walk to the downriver end of the village. They enter each house in turn, encircle a man, tug gently at his shirt or belt, and sing in Culina, "We are sending you to the forest, hunt for us, bring us back meat." They go from house to house, from man to man. They ignore an old man who no longer hunts and pay no attention to the pleading eyes of a seventeen-year-old who yearns to be included as a man. He is still only a hunter of small birds and lizards, still afraid to go deep into the forest after peccaries and tapirs, deer and howler monkeys.

Most men, even though surrounded by the women, ignore them and continue what they are doing—cleaning a shotgun, mending a shoe, or playing with a small baby—with no change of expression. One young man, however, teasingly pulls a girl's hair in an attempt to distract her and to convince her that she should choose him to send on the special hunt.

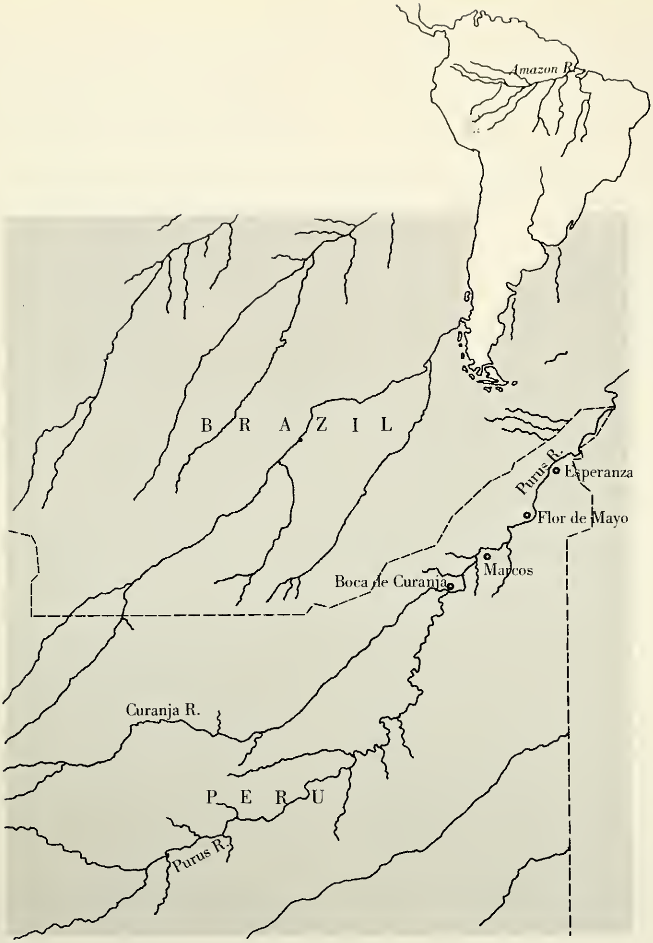
By the time the women have repeated their song to every man in the village, the shadows have turned to darkness—broken by the sparks of the fire beetles and the glint of kerosene lanterns piercing the slits in the bark walls of the houses—and the frogs have begun their almost deafening, grunting concert. Each woman now returns to her house. Soon the kerosene lanterns are turned down, the moon rises. Tomorrow there will be meat.

The stars have faded only slightly when the sounds of the village begin. The crows of one foolish rooster, which have broken the stillness several times earlier, are finally justified by the faint definiton of house shapes emerging from the darkness. A woman's hammock ropes creak as she rises and puts her dress over her shoulders against the chill air. She walks over to the cookhouse and picks up a still-warm log, blows on one end until it is red, places it against another log, and squatting comfortably, blows until the wood breaks into flame.

The children wake and move in close to the fire. The baby is handed to an older sister, who places the child in a woven sling, which she puts over her shoulder to support the baby's weight as she fans the fire. The woman and two other girls each take a metal pot and head down the path to the river's edge. Covered with mist, the river is barely visible. The woman bathes close to shore; the water is warmer than the chill air. Her small daughter balks but is told that she is like a dirty Culina, so she strips, dashes in, and splashes herself for a brief time. She fills her tiny pot with water and wriggles back into her dress. She walks smugly across the clearing to her house, her wet hair proof of virtue, her small pot of water attracting favorable adult comments.

In her house, the woman now puts a pot of water on the fire and throws in large, fat plantains, fanning the fire to keep a rapid boil going. While her husband takes his turn to bathe in the river, she skillfully twirls a many-pronged mixer in the pot, mashing the soft

Older girls traditionally paint the faces of their younger sisters.



cooked plantains into a soup. When the husband returns he dips an enameled tin cup into the pot. The older sister dips in another cup, offering a taste to the crying baby, and the woman fills a delicate gourd bowl to share with the younger children. The soup is hot and sweet. The baby demands its mother's breast, so the older sister hands baby and sling to the woman.

Carrying his shotgun and his huge, spade-shaped canoe paddle, heavy to use but fast, a man from another household joins the husband. The visitor drinks a cup of the plantain soup; then the two men leave, heading toward the river. The young son-in-law goes to another trail to join another canoe.

The men push off their canoes, paddling downriver into the mist. The sun is just beginning to cast shadows and warm the air. A half hour later the mist has burned off the river and the clear colors of the morning are met by swarms of sun-loving gnats. The river is still high at the end of the rainy season.

Women and children at each house finish their breakfasts around the cookhouse fire: a few pieces of manioc roasted next to the fire, more plantain soup; but no meat, no fish. In each household one wife or older daughter stays with the youngest children as the other women leave for their manioc gardens, a half hour walk or canoe ride from the village.

The morning is always the quietest time, especially today since all the men, except for the old man, have left. On most days only a few men hunt or fish with bows and arrows along a lake shore. Another man may lie alone in his hammock or repack a plastic shotgun shell with the pellets dug out of the game he shot the day before. An older man may twist a basket for his wife's spun cotton. A father may make a tiny bow and arrow for his small son, then watch and laugh affectionately as the boy gravely stalks a butterfly.

Today a group of older boys chase each other along the river, splashing into the water and playing a game that is half tag and half a mock rape of one another. They are almost out of earshot of the village; their laughing obscenities not quite audible. They have given up their usual hunting or fishing expedition, since the special hunt will assure them of plenty to eat. They are expert shots with the two-foot-long bows and short, straight arrows that they make for themselves or for their younger brothers. With these they hunt small birds, lizards, fish, and frogs, which they eat for lunch, but they have not yet mastered the 5½-foot bow that the men use, and no one would trust a boy with a precious shotgun.

As the sun moves up in the sky, the women start back from their manioc gardens, the heavy thatch baskets of manioc pulling the fiber rope against their foreheads. Their jaws, locked grimly against the pull, do not relax until the women back the baskets onto the raised floors of their houses.

In each household the women easily divide the tasks between co-wives (who are often sisters) and daughters. One woman picks up an ax and an empty basket and walks to chop firewood in a nearby garden. Another sits and peels the stiff brown skin off the manioc with a

machete, then lines the largest pot with broken twigs and places the tubers on the rack of twigs so that they will steam above the boiling water. She stacks the tubers to the very top and covers them with banana leaves tied carefully around the pot's edge with fiber. These daily chores completed, a quick bath and a small snack follow. Then the women begin their work for the special hunt.

They scoop bowls of ripe corn from the large thatch storage baskets and spread the kernels out over the fire on a thin, flattened-out piece of tin, the remains of a large cracker can brought by missionaries. One woman watches the browning corn, carefully spreading and turning it to roast evenly, dumping it into a large wooden mortar, then roasting another batch. Another woman pounds the heavy pestle against the corn. Women from other households bring their own roasted corn to share the mortar and pestle and relieve each other from the tiring work of pounding the corn to a fine flour.

One woman, who has no corn left, asks her older co-wife for some of hers. The older woman agrees and helps with the work, even though she will not take part in the special hunt, except to watch. She did not join the younger women singing, and she will not receive meat from a hunting partner. On most days game is brought to her by her husband or her son-in-law. She cuts it up and sends large pieces to other households.

Today the younger women will receive the game, but from a man who is neither a member of their household nor a close relative. As the women work, they discuss which one will wait for each man, and their talk is full of gossip. In the special hunt, women often pick their lovers as partners or indicate their interest in a new lover. The women of this household gossip particularly about Tomuha, who is sending two men to hunt for her. It is unusual but permissible, even though two women cannot send the same man.

Solemnly, the men return from the special hunt to be met by a row of festively dressed women.

One woman says that she is unlucky because she has sent a man to hunt for her and her husband is jealous. The women sympathize with her bad luck. If her husband ever gets drunk, he may threaten to kill his rival, but he will not carry out the threat. Instead, he will hit his wife, and she will run to hide, while older people talk her husband into his senses.

Another woman complains that her customary partner is away, that she has too many kinsmen in the village, and that there is no one for her to send. The women consider the possibilities and come up with a young man who is visiting another house and has not been chosen. They finish pounding the corn, mix it with water to make a drink, and put it aside.

The women bathe again and return, their skins cool and fresh; they put on their best dresses and their full wealth of beads, and paint their faces and legs. A woman rubs a thin layer of red achiote all over her face, then, looking into a small mirror propped up against the wall or on her lap, she dips a sliver of wood into the juice of a genipa fruit and starts to paint an elaborate design in thin black lines. The first stroke is always the same—a straight line from the corner of the mouth to the lobe of the ear. This line used to be permanently tatooed and can be seen on women over twenty. It identified them as Sharanahua. The fashion has now changed; no one tatoos anymore, but the line orients the face-print design.

The patterns that follow the first stroke vary only a little from woman to woman, day to day, but they are always symmetrical. Most men also paint their faces, but less frequently than women. Older boys awkwardly manage a few lines, but older girls are expert at decorating their own and their younger sisters' faces.

The design reduces the individuality of a face by creating an elegant pattern. Sharanahua women, in contrast to ourselves, have no need to enhance their individuality since they are not in competition for men's favors. In this polygynous society there is always a shortage of women, and girls learn to take it for granted that men will pursue them. A Sharanahua man, speaking with longing of a woman he has met, says, "She was beautiful, her paint was lovely."

At times, face paint symbolizes the opposition, as well as the attraction, between men and women. In the special hunt, men must prove their virility by bringing in game to gain the favor of the women who have sent them. In everyday life as well, men hunt to impress the women. When children scream at their mothers, "I want to eat meat!" the mothers' reply, "There is no more meat," is a goad to provoke the husbands to hunt again. It implies that they are less than men since there is no more meat. Equating hunting with manhood carries a sting—the good hunter is the virile man, but the hunter with little skill or bad luck does not find compassion.

Once during the height of the rainy season, one man, who had spent many hours in the forest, returned empty-handed, tired, and muddy. No words of sympathy were offered. The women of his household painted their faces, and one said loudly, in a voice that carried clearly to the hammock where he sat picking forest ticks off his body, "We want to paint, there's no meat, let's eat penises!" When the women paint their faces and put on their beads and best dresses, it is an open challenge to the men.

In the early afternoon on this day of the special hunt, one of the boys

runs down the village path, shouting that the men are coming back. The boys playing along the river have picked up the still far-off sounds of men talking and water splashing against the dugouts.

Some young women run a short way into the forest to find branches of stinging nettle, which they put away for later use against the men. The women, fully painted and dressed, walk over to the largest house and wait, looking across the clearing at the path leading up from the river.

Finally a canoe turns the bend a quarter of a mile away, followed by two more canoes filled with men. At the bow and stern of each canoe a man stands, leaning his weight against a long pole, pushing the canoe through the water.

The women are quiet, listening but not responding as the boys announce, "There's lots of game! Lots of meat!" After racing down to the river and back again, the boys report that three men have not come back. Later it is learned that they went deeper into the forest, trying to pick up the tracks of a herd of peccaries that were rumored to be moving through the area. The other men had waited by the canoes to return together, but as the sun passed the height of noon, they started back upriver to the village to bring their game to the waiting women.

Each man adjusts the fiber strap that secures a large howler monkey, a wild turkey, or a spider monkey to his back. He holds his shotgun in one hand and walks up the narrow path to the clearing to face the row of painted women. Solemnly, without a word, he crosses the clearing, tosses his game to the ground at their feet, and walks up the path to his own house.

No man faces the women empty-handed. Two of the important men failed to kill game. They returned to the village with the others but walked a back trail to their houses, avoiding the clearing. They now sit in their hammocks, glum and silent.

The women pick up the game, each taking the animal her partner has brought, and the hum of conversation resumes.

The men bathe and rest in their hammocks, refreshing themselves with plantain soup as the women in each household rapidly skin, quarter, and cut the meat into chunks. A hungry dog starts edging over, but someone hits it hard on the back with the flat side of a machete. It retreats, yelping with pain. The women exclaim over a small piece of fat and put it in a leaf to roast with the liver. They throw the intestines into the bush, and the dogs run to seize them. The meat is dropped into the large pot to boil. Each woman takes the bowl of corn drink made earlier and walks to the house where her partner rests, where she places it on the floor next to his hammock.

Within an hour food is set out. In every house there are several flat baskets of steamed manioc, enameled plates of meat, and some bowls of broth, salted and made fiery with one or two small peppers. Men share the food with their small sons; the older boys eat with their brothers; and the women and girls share their food. People begin to wander to kinsmen's houses to eat some more.

Suddenly, a group of young women appear in the clearing, laughing and carrying branches of stinging nettles. A young man starts to back away; then breaks into a run, dodging the girls who chase him. He runs around the house, two girls racing after him, only to collide with the others as he comes around the corner. He surrenders, stands still, and grins as they rub his arms and neck with the leaves to give him strength. In a minute the itching starts, and as the girls catch their next victim, the first man grabs a branch of nettles and starts after them. Within minutes the village is a free-for-all—groups of men and women, girls and boys, all with nettles in their hands laugh, shout, run, and dodge around the clearing and up the paths. The children imitate the adults, with boys pursuing girls, girls attacking boys.

The young women, red from the exertion of running in the afternoon sun, stop for a moment to complain boastfully of how they itch from the men's attacks with the stinging nettles.

A different game now begins as a woman places a fiber band around a man's shoulders and he circles her waist with another. Holding the ends of the bands in their hands, they lean back, pulling and shifting their weight. They circle, tugging and laughing—then with a sudden release of tension, the woman falls. Several pairs try to toss each other, and a few women pit their weight against one man. While women play hard in these games, they should not win, and no woman uses her full strength against her opponent.

There is a pause for a few minutes as the players take a sip of corn drink or plantain soup. A young man breaks off a piece of sugar cane and walks by a row of women, teasingly tapping them with the cane. Two women chase him, reaching for the cane, which he holds high above his head. Then he runs again as several other women join in. Almost surrounded by them, he throws the cane to another man who mockingly eludes the women. Several other men block the women's path. The women rest for a moment, but they renew the chase in response to the man's teasing gestures. They almost have a hand on the cane, when the man twists away, and throws it to still another man. Again the women try for the cane, but do not succeed. Women's success is measured, not in these games, but in their skill at sending the men to hunt for them.

The games stop slowly as people drift off, heading down to the river to cool off and to soothe the itching caused by the stinging nettles. By late afternoon the village is quiet; families are eating in their own houses.

From one house comes a wailing chant, a chant sung by women when someone is sick or has left the village. The three missing men have still not returned from the forest, and the women weep fearfully.

Each woman picks up the game that her partner in the hunt has brought. Within minutes it is cooking over a fire.

Darkness is only half an hour away, and the forest is filled at night with hungry spirits who crave the fat, the liver, and the meat of humans.

Concern spreads, and in the next house the men are talking worriedly. The fire beetles are already out and the kerosene lanterns glimmering when, from far down the river, a call is heard over the sounds of frogs and crickets. The three missing men have returned. Smiling broadly, each slings a large peccary off his back and onto the floor. They bathe in the river and sit content in their hammocks as their partners cross the darkness to bring them bowls of corn drink. ☐

KEN RINCIARI

by Luther P. Gerlach

Keeping Afloat in a Changing World

ARK II, by Dennis C. Pirages and Paul R. Ehrlich. *The Viking Press, $8.95; 344 pp.*

Our Dominant Social Paradigm (DSP) is defective, obsolete, and must be changed, say Dennis C. Pirages and Paul R. Ehrlich. (DSP is their way of referring to what others conventionally have referred to as culture, social system, lifeway, or what have you.) According to the authors, in following our present course we will surely travel to ecological and social collapse. The DSP cannot cope with emerging and linked problems of environmental degradation, resource depletion, overpopulation, and the pressures of growth. We must transform to a new social-cultural paradigm, or model of life. This new DSP will stress maintenance of steady state instead of growth and "cowboy economics." Within our society we must find new and more equitable ways of redistributing opportunities and income to close the now widening gap between rich and poor. Internationally, as one of the major overdeveloped countries, we in the United States must change the way we exploit and interact with the less developed countries. We must curb the power of multinational conglomerates and find ways to make business and industry serve the people, even if this means nationalizing some businesses and industries and breaking up many of the conglomerates.

In the past we could perpetuate the myth of equality of opportunity by growing economically. We could believe that "have-not" Americans and less developed nations could eventually progress and move up the socio-economic ladder without pushing anyone off, without taking from the "haves." But, say Pirages and Ehrlich, now that we face major shortages, we will find that the gain of some must be at the cost of others. To prevent national and international conflict over resources and opportunities, basic values and socio-economic structures must be changed. The authors explain that we must devise bold new ways to prevent the "tragedy" of overusing the limited resources that people hold in common. We experience a situation in which individual (private) actions that are perfectly rational in themselves, given the DSP, add up to bad public choices, especially considering the new conditions of environmental degradation, resource shortage, and overpopulation. For example, myriad private actions, such as driving cars, living in suburbs, working in cities, and searching for energy-intensive comfort, add up to the public problems of air pollution, energy crisis, and traffic congestion.

The underpinning of our troubles, Pirages and Ehrlich continue, is our commitment to "one-dimensional thinking." We use tunnel vision and see only part of the problem. We should move to systemic thinking, that is, to a holistic approach, in which we consider how actions in one part of a system affect the other parts. If we sail into the future guided by DSP, limited by one-dimensional thinking, aiming for ever more growth, with a crew that has ever rising expectations of sharing in an ever progressing good life, then we shall surely flounder in predictable storms and sink.

Yes, we can forecast doom just over the horizon if we keep on our present course. But after warning us of this fate, the authors update Noah and offer hope for survival if we help them build a new system of living—Ark II. We need a new social vessel, a new course, a new leadership, and a public that is educated to expect less, share more, and think of the social and ecological consequences of their private actions. Since problems are so many, so complex, and so interactive, we need new levels of system planning and management and new modes of control and regulations. The old free enterprise, *laissez-faire* system is obsolete. We can't rely on the "invisible hand" of conventional market supply-and-demand forces to deal with emerging problems. We cannot afford to "muddle through" but must take bold, heroic action on a vast scale. There are risks in this, Pirages and Ehrlich admit. There is some threat to freedom and innovation, as the example of Czechoslovakia in the 50s and 60s shows. Centralization can also fail to provide people with the social and economic life they desire. But on the other hand, the free enterprise system has already been killed by world conditions. Conventional wisdom and large corporations stifle innovation and competition. One approach to imposing the necessary controls, the authors suggest, is to "concentrate governmental regulatory activities as far 'upstream' from the individual as possible, thus minimizing the perceived restrictions on an individual's freedom." They follow B.F. Skinner in stressing that people are not really free in any case but are always constrained by their culture and socialized from childhood to conform. The trick, therefore, is to design a new culture and quickly socialize people of all ages to it without really seeming to impose onerous restrictions. Education and the mass media provide the avenues to help people see the need to change and be resocialized. This, of course, means that education and media must be changed, for, both presently serve the interests of the *status quo* and perpetuate the obsolete DSP.

Pirages and Ehrlich indicate that conventional wisdom would lead us to seek solutions to our problems simply by trying harder and on a greater scale that which has brought us to our present dilemma. We will try to keep the old boat afloat by patching and repairing it, trying new technology, spending more money, and searching for more growth to pay for it all. But they say that there is no hope in such action. We cannot "fix it" by technology. The only hope is sweeping social change. Just as we have learned to understand and intervene in the process of biological evolution, we should be able to understand and intervene in the process of social evolution.

Does all this sound familiar? It is, I trust, a reasonable summary of what Pirages and Ehrlich say in *Ark II* (although no brief review can do justice to a book that seeks to cover as much as this one does). The book is typical of an emerging conventional wisdom among a rising group of people who question the established way of American life, urge or hope for fundamental change in it, and warn of, or at least worry about, dire consequences if we do not change. The *Ark II* authors say that they are worried because not enough people are pressing for and searching for the basic change that is needed. They indicate that the forces to maintain convention are too strong and entrenched. At times they seem to feel a mission themselves to bring about change, but at other times they imply that the transforming mission should be that of "a dedicated group" of "active and rational nonviolent revolutionaries" yet to be assembled. They hope that "mankind" will be fortunate enough to have "those concerned with the future" construct "a revolutionary vision of a new world and to outline ways in which society might make a transition to it." In any event, they seem to imply that in warning of the deluge and in proposing the construction of a world-saving vessel, they are all but standing alone and speaking to a disbelieving public, which is firmly anchored in a bedrock DSP.

In fact, I suspect that most of those who read *Ark II* will already share many of the authors' ideas and will have discussed or debated most of them, agreeing with some, disagreeing with others. As I see it, many people across the range of American society do recognize major faults in the system, do worry that some old ways are no longer appropriate, and are already searching for solutions. At least since the mid-60s many people have been forming groups that question established ways and explore new possibilities. Some such groups, interacting in networks and sharing common aims and ideas, composed the forces for change that we referred to as social movements: Black Power, Civil Rights, Consumerism, Environmentalism, Women's Liberation, Anti-War, and so on. Other groups have organized to deal with community problems. Some, like the independent truckers, organized to protest inflation and the power of the oil cartel. Everywhere groups of people seek ways to participate in decision making and resist top-down control by established powers. Certainly, these are not *the* one dedicated group, which Pirages and Ehrlich seem to envisage. They have their moments of intense activity and then often fade away, to be replaced by yet another group spurting into action of another type. Many may not have the level of expertise that Pirages and Ehrlich might find necessary. But in the interest of increasing the diversity that the authors otherwise extol as being ecologically sound, is not such broad variation desirable, especially in this time of uncertainty? Sure, if we put all energies into an ark piloted by the Pirages and Ehrlich group we might luck out and get our better future and maybe not "perceive" that it restricted our freedoms too much. But what if the thing takes a wrong turn? Or what if we have a mutiny on this, our one and only vessel into the uncharted future, perhaps because people fear an end to their freedoms? Why not instead have many ventures, sailing off in many directions, communicating to each other which ones work and which ones fail, which find new land, new hope, or new harbors? As far as I can tell, this is indeed what we already have. Ark II has just joined the fleet. Hopefully many people will look it over. It is well crafted and should attract a good crew and many admirers among the many people who already are embarked on the transforming quest.

A closing thought: As readers ponder *Ark II* and similar essays that urge fundamental social transformation in order to achieve a steady state in America, they would do well to reread key essays of the 50s and 60s that dealt with the transformation of the "underdeveloped lands" from steady state to growth. At first, experts expected that we could develop these lands by infusing Western technology and money. But in time, many specialists (like the economist Everett E. Hagen) realized that development required fundamental change in all aspects of the social system, not simply a technical fix. Characteristically, development experts bemoaned the way "traditional peoples" stifled necessary entrepreneurship because they believed that their resources were so limited that the gain of one, in excess of some socially fixed amount, was bound to be at the cost of another. Some specialists, notably psychologist David C. McClelland, believed the answer was to help traditional peoples develop the "need to achieve." Everywhere we helped promote the escalation of expectations to help people "progress."

Some experts on development, in particular W.W. Rostow in *Stages of Growth*, used evolutionary analogy (much the way Pirages and Ehrlich do) to say we must help societies evolve to higher levels characterized by increased growth, production, and consumption. Elites rose to power in the developing lands, seeking ways to plan and manage such evolution. Often they felt that people would at first resist the restrictions on their customary freedoms that this would entail, but to achieve the greater good for the future they were willing to combine force and persuasion and apply education and media.

In short, everywhere the problem was how to leap from traditional steady state, no-growth systems by adopting the very paradigm of achievement and economic development that many people, like Pirages and Ehrlich, now warn is so defective—at least for the "overdeveloped countries." The socioeconomic evangelists of the 50s and 60s prophesied global doom if we did not help others break the constraints of steady-state life, take off up the stages of economic growth, and become, along with us, achieving societies. The many converts to this message have helped spread and implement growth and rising expectations everywhere with such success that now we must worry about global limits and eco-collapse. What, we wonder, will be the consequences of heeding the new evangelists of steady state? Is theirs the real path to social and ecological salvation?

Luther P. Gerlach is professor of anthropology at the University of Minnesota and author, with V.H. Hine, of People Power Change, Movements of Social Transformation *and* Lifeway Leap: The Dynamics of Change in America.

THE PACIFIC ISLANDERS, by William Howells. *Charles Scribner's Sons, $12.50; 299 pp., illus.*

Although the Portuguese and the Spaniards, with the Dutch on

4/5 QUART
JACK DANIEL'S
OLD TIME
Old No. 7
Tennessee
SOUR MASH
WHISKEY

JACK NEWTON DANIEL made whiskey in 1866 by a method called charcoal leaching. We say charcoal mellowing today.

Whatever you call it, you start with hard maple from the Tennessee uplands and burn it to char. You grind this charcoal to the size of small peas and tamp it tight in vats. Then you trickle whiskey down through the vats to mellow its taste. Around 1945 we changed the name of this method from *leaching* to *mellowing*. It seemed a better way of describing it. But that's the only part of Mr. Jack's process that needed improving.

CHARCOAL MELLOWED
💧
DROP
💧
BY DROP

Tennessee Whiskey • 90 Proof • Distilled and Bottled by Jack Daniel Distillery
Lem Motlow, Prop., Inc., Lynchburg (Pop. 361), Tennessee
The first Distillery placed in the National Register of Historic Places by the United States Government.

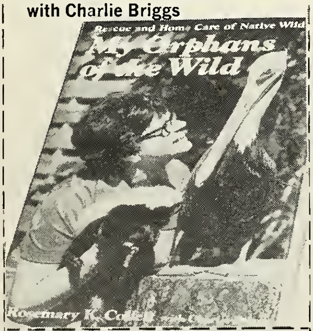
HELP!
Injured wildlife needs it...now you can give it.

Somewhere near you, there is a wild creature who needs your help—an oil-damaged bird, an injured raccoon, a motherless baby sparrow. And in this book you can learn what to do about it from an expert. Rosemary K. Collett, an officer of the Florida Audubon Society, runs the Felicidades Wildlife Foundation, where she takes in, treats and feeds all kinds of creatures until they are strong enough to be released. Now she has written MY ORPHANS OF THE WILD—the only book of its kind—to show *you* how to care for wildlife in trouble.

MY ORPHANS OF THE WILD explains all you need to know about medication, first aid, diet, housing and handling of 69 kinds of birds and beasts—a treasury of information not available from any other source. Dozens of action photos and heartwarming stories show you the kind of satisfaction you will gain when you help sick and injured creatures.

Marlin Perkins, the noted zoo director and host of TV's "Wild Kingdom," calls it "simply wonderful . . . a book that has been badly needed for a long time." Order your copy today with the coupon below.

MY ORPHANS OF THE WILD
Rescue and Home Care of Native Wildlife
ROSEMARY K. COLLETT
with Charlie Briggs



J. B. LIPPINCOTT COMPANY NH-1074
P.O. Box 7777-R0400
Philadelphia, Pa. 19175

Send me, postage paid, ...copy(ies) of My Orphans of the Wild at $8.95 ea. I reserve the right to return the book(s) within 10 days of delivery for a full refund.

Name. . . . .

Address. . . . .

City. . . . .

State. . . . . Zip. . . . .

Residents of Pa., N.J., N.C., N. Dak., Ark., N.M., Cal., Tenn., please add state and local taxes.

their heels, had made landfalls and established settlements in Indonesia at the very outset of the Age of Discovery, the rest of the Pacific islands were among the last of the great areas of the world to be thoroughly explored. Aside from a few reports of islands seen or visited by Spaniards crossing from South America to the Philippines and the incidental discoveries of seventeenth-century Dutch seamen, it was not until the eighteenth century, and well into that, that systematic voyages of exploration of this vast domain were undertaken by the French and the British. And none of these were more systematic and fruitful than the three voyages made by Capt. James Cook between 1768 and 1779. Much of the impetus that led to these discoveries can be attributed to science. Cook's initial voyage was designed to provide the Royal Academy with astronomical readings on the transit of Venus as observed in Tahiti. And equally important was his search for the Terra Incognita, or southern continent, which contemporary science had inferred must exist in the southern Pacific to balance the land mass and weight of the earth's Northern Hemisphere.

The opening up of this new world of the Pacific islands raised a number of problems. One of the most entrancing was identifying the various and obviously very different kinds of populations that dwelt on these scattered islands, stretching all the way from Southeast Asia to Easter Island and from the Philippines and Hawaii south to Australia and New Zealand. Cook, and his fellow voyagers Banks and Forster, for example, were especially taken with this problem and made sound observations that stand up even today. They were among the first to recognize that the Polynesians formed a distinct unit despite their enormous distribution over thousands of miles.

The origin of these various peoples, Australians, Melanesians, Indonesians, Micronesians, and Polynesians, has remained a perennially fascinating puzzle. Anthropologists, linguists, archeologists, and just plain speculators have created a vast literature on this problem. Scarcely an area of the earth has escaped being singled out as the homeland of this or that variety of Pacific island people. Polynesians,

actual
size

oneness

A subtle linking of man's religious symbols, delicately wedded together by the artisan.

With illustrated descriptive booklet

14K with 24" chain $37.50
Sterling Silver $16.75

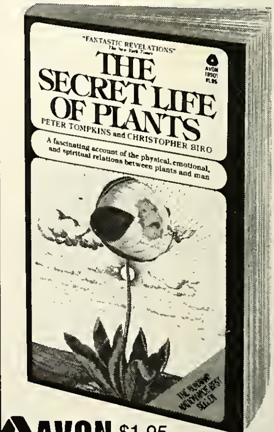
ISAAC SOLTES DESIGN NH
1923 S. McPherrin Ave.
Monterey Park, Calif. 91754
Check or Money Order / Money-back Guarantee

AZTEC–MAYA LAND CRUISE

An unprecedented program in Mexico. Great archaeological sites, untouristed villages, stunning scenery. 31 days of magnificent diversity. Frequent departures. Brochure - your travel agent or

WORLD TRAVEL ASSOCIATES, INC.
219 Palermo Ave. Coral Gables, Fla. 33134

Now in Paperback!


"FANTASTIC REVELATIONS"
AVON
THE SECRET LIFE OF PLANTS
PETER TOMPKINS and CHRISTOPHER BIRD
A fascinating account of the physical, emotional, and spiritual relations between plants and man

AVON $1.95

STERLINGSILVERSNOWFLAKES
INTERPRETATIONS OF THE BENTLEY PHOTOGRAPHS

PENDANT 2¼ DIA

"HOLLY BERRY FLAKE"
WITH GARNET OR TURQUOISE CENTER
IN A LIMITED EDITION OF 50 NUMBERED PIECES
$65 EA POSTPAID

The Silver Shop
HELEN BECKERHOFF BOX 62 STOWE, VT 05672

The entire population of earth fitting into an aspirin-size pill. Pulsars that blink on and off 30 times a second.

These and other celestial oddities are

BEYOND THE KNOWN UNIVERSE

From Dwarf Stars to Quasars
by I. M. Levitt, Director Emeritus, The Fels Planetarium

"Brings the whole subject together in a masterly fashion. ...I commend it to your attention."
—Patrick Moore,
Director of the Lunar Section of the British Astronomical Association

Illustrated
$10.00

THE VIKING PRESS
625 Madison Avenue, New York, N.Y. 10022

Share an unforgettable experience in

THIS LIVING REEF

text, photographs, introduction and commentaries by Douglas Faulkner
13⅜" x 9⅛" • 196 pages • 112 pages of 6-color photographs

The coral reef is perhaps the most intriguing environment the natural world offers us. It is explored in this new volume with an extraordinary combination of poetry and science, fantastic imagery and vivid color by Douglas Faulkner, the world's finest underwater photographer. Concentrating on the Palau Islands of Micronesia—a "collector's matched set" of reefs and islands—THIS LIVING REEF is a book of breathtaking beauty as well as scientific achievement. A Main Selection of the Natural Science Book Club. $22.50. At your bookstore or by mail to Quadrangle/The New York Times Book Co., 10 East 53rd St., N.Y., N.Y. 10022

for example, have been derived from Egyptians, Aryans, Indians, Chinese, Malays, and American Indians, as well as varying combinations of these and other original populations.

Even the recognition of the various genetic strains that make up the populations of the different island groups has been a matter of considerable controversy. This has been especially true for Indonesia and Melanesia, where physicial variation from one archipelago to another is often highly notable, sometimes even within a single archipelago.

To this vast and complex situation William Howells, in *The Pacific Islanders*, has tried to bring some order. And he has, although he does not claim to have answered all the questions. Using the new computer techniques for the analysis of physical variation, he has identified, at least tentatively, some of the more significant elements that make up the population elements of the area. Then, with the insights derived from current linguistics studies, he has tested out his findings. And these have been examined in the light of recent revolutionary archeological discoveries.

The results of all this are somewhat complicated, and under another pen might be difficult for the uninitiated to follow. But Howells has a gift for exposition, a lively style that manages to capture the reader's interest. In addition, he is completely honest in appraising his own work; where he becomes speculative he warns the reader with disarming frankness. I know no other book that attempts with such competence the job of unraveling the strains that make up the people of the Pacific.

Harry L. Shapiro
The American Museum

PEYOTE HUNT, by Barbara G. Myerhoff. *Cornell University Press, $15.00; 285 pp., illus.*

The Huichol of remote western Mexico possess today what is probably the closest to the aboriginal peyote cult still extant among American Indians. As such, their ritual is of special interest, since many of its elements serve to explain what is otherwise obscure in the familiar Plains rite. Why, for in-

Vertigo and the Uncommon Cold.

Dizziness, nausea, falling — they're results of Meniere's Disease. The old treatment was inner ear surgery which cured the vertigo . . . but killed the patient's hearing.

Now, due to pioneering work by Presbyterian's Dr. Robert Wolfson, there's a new treatment. Cryosurgery — chilling the inner ear to 256° **below** Fahrenheit — has been found an effective cure in seven out of ten cases . . . with no hearing loss!

Although dramatic, such research breakthroughs are only a part of our service at Presbyterian-University of Pennsylvania Medical Center in metropolitan Philadelphia. Each year, "Presby" treats over 10,000 in-patients and 100,000 out-patients without regard to the sufferer's pigmentation or pocketbook.

Now we need your support. Think of us when you are making up your will. Better still, help us now. Our life income plans offer generous, steady income — plus tax benefits — while letting you know you are helping those in pain and need. That's worth doing. We're worth knowing. This no-obligation coupon starts it all.

The Name Is Presbyterian.
The Mission Is Mankind.

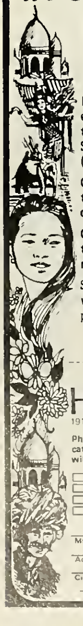
Presbyterian-University of Pennsylvania Medical Center*
Planned Giving-Development Office
51 N. 39th St., Phila., Pa. 19104

Please send me no-obligation information on your investment plans.

Name
Street
City State Zip

*A validated cause of the Philadelphia and Donegal presbyteries

The Circle of
SEASONS
**by Dennis Stock and
Josephine W. Johnson**
The endless continuum of nature is subtly and exquisitely revealed in the color photography of Dennis Stock, intimately interlaced in mood and spirit with Pulitzer Prize-winner Josephine Johnson's perceptive text. Truly a book for all seasons, it celebrates the simple but bountiful enjoyment of all living things and the familiar forms of life that inhabit the earth at various times of the year. "A shimmering treasure."—*Publishers Weekly*
A STUDIO BOOK
64 pages of color photographs
$16.95
THE VIKING PRESS
625 Madison Avenue
New York, N.Y. 10022



there's no trip in the world like one around it!

Leave the beaten track on an expedition into the high Himalayas, to lofty mountain domains like Sikkim, Assam, Hunza and Chitral (for either 40 or 61 days).

Or take a once-in-a-lifetime journey to hidden corners of the world south of the equator. . .57 days.

Or travel 53 days from Hong Kong to Beirut through Asia old and new. . .

Send today for our free around-the-world brochures. Creative travel planning by Hemphill.

HEMPHILL TRAVEL CORPORATION
1910 West Sunset Boulevard, Los Angeles, Ca 90026

Phone (213) 483-3440 or write us for our free catalogs. Send us the name of a friend and we will send them some also.

☐ Isles of the Orient
☐ South Seas
☐ Yuletide in Europe
☐ Christmas Fiestes
☐ Amazon Expeditions
☐ South America
☐ E. Africa Tent Safari
☐ Around the World

Mr/Mrs./Miss
Address
City State Zip
Phone Number

stance, do the Cheyenne of Montana, in their ritual peyote breakfast, specifically eat canned peaches, corned beef, and, of all things, Cracker Jack? The explanation is that in the original first-fruits ceremony the required foods were stoneless fruit, boneless meat, and parched corn in honey water—all of which the modern foods sufficiently symbolize to tribes that have long since forgotten the ancient meanings.

In her well-illustrated and pleasantly readable book, Barbara Myerhoff has shown further that the sacred peyote journey (twenty days, each way, on foot) illustrates the past history of the small (3,000–4,000) Huichol tribe. Initially hunters, under the influence of central Mexican tribes the Huichols became maize growers, but their rich symbolisms faithfully preserve their hunting past. Peyote, a small cactus plant, is symbolically stalked and shot with an arrow, as though it were a deer; and maize, the staple plant food, is equated to deer meat and thus to peyote. Peyote is the life stuff, like fire, and deer, peyote, and maize are one. The ritual hunt for peyote is thus literally "to find our life" in the shaman-led pilgrimage to the distant regions where peyote grows.

In addition to Elder Brother (deer), Grandfather Fire (Tatewarí, the first shaman) and the Corn Mothers are ritually implicated. All these, and other gods, are pictured in the famous Huichol mosaic "paintings" made by coiling brightly colored yarns on a board covered with beeswax. These vivid paintings illustrate not only tribal legends but also individual visions obtained under the influence of this hallucinogenic cactus, which is eaten during the ritual. From Carl Lumholtz to Barbara Myerhoff, anthropologists have studied the unusually rich symbolism of Huichol peyotism. The sacred cord encircling the seated *peyoteros* symbolizes their ritual unity. The sacred land of Wirikuta, where peyote grows, is timeless, and the present ritual is equivalent to the original of legendary time. The *peyoteros* themselves embody the ancestral gods.

Some elements still found in Huichol religion are surpassingly ancient: deer horns and bones as containing the life force; the Master

We offer an entirely new program for 1975

The Papillon Tour

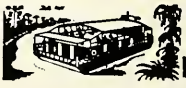
Between July and November, 1975, we have arranged four escorted 11-day tours, to photograph and enjoy the birds, butterflies and jungle wildlife of Trinidad and French Guiana

In Trinidad we stay at the lovely Asa Wright Nature Center in the northern mountains of Trinidad; and in French Guiana we visit Cayenne, the Iles du Salut, and stay for three days at a camp deep in the jungle where transport is by canoes and accommodations are in hammocks in open-air bungalows.

Detailed brochure available from:
HANNS EBENSTEN TRAVEL, INC
55 WEST 42 STREET, NEW YORK, NY 10036
TELEPHONE (212) 354-6634

STRANGE ARTIFACTS
A SOURCEBOOK ON ANCIENT MAN
Compiled by WILLIAM R. CORLISS
Over 100 articles on Stonehenge, Scottish Fused Forts, Phoenicians in America, ancient Arizona canals, and other mysterious artifacts as originally printed in *Nature*, *Archaeologia* and other publications. Thorough index.
262 pages, hard covers, $6.95 postpaid
Published by
WILLIAM R. CORLISS
BOX 107A, GLEN ARM, MARYLAND 21067

EXCEPTIONAL 5-ACRE RANCH. Lake Conchas, New Mexico. Only $995 per acre. Vacation Paradise. Good long term investment. Easy Terms. Free brochure. Ranchos, Box 2003NH, Alameda, California 94501



CRUISE INLAND FLORIDA

Relax 5 days on the Lazy Bones plus airboat and swamp buggy jaunts in Everglades country. $187 complete. Mid-Dec. thru April. Featured on Jack Douglas TV series. For brochure and reservations write:

Capt. Stan Maurer SHANTY BOAT CRUISES
Box 3660, Fort Myers, Florida 33902

100
WORLDWIDE
STAMPS
..only 10¢

GET this giant collection of 100 different stamps from the world over—Virgin Islands, Rwanda, Hungary, everywhere. New countries, new commemoratives, pictorials, topicals. Get Eisenhower memorial, giant. lion, Unicef, others shown plus many more new, old issues. Colorful valuable stamps—wild animals, famous people, far places. Also stamp selections to examine. Buy any or none, return balance. Cancel service anytime. Rush 10c today for your valuable collection.
GARCELON STAMP CO., Dept. ONHR, Calais, Maine 04619

Life history—
survival chances
HORSES, ASSES AND ZEBRAS IN THE WILD
By Colin P. Groves

The different types of wild horses and their relatives, the asses and zebras, are described here in detail. Study for all those interested in horses and their origins, and for those concerned about the threatened extinction of many of the species.
191 Pages With 28 Black & White Photos, 4 Drawings and 8 Distribution Maps. 8½" X 5½".
I.S.B.N. 0-88359-008-5. ....$10.00

RALPH CURTIS BOOKS
2633 Adams Street
Hollywood, Fla. 33020
PUBLISHERS

Write for our complete list of Wildlife - Zoological books from all publishers.

HANDMADE JEWELRY FROM
IRELAND

A

B

C

The inspiration for these enamel on brass pins comes from the ancient Book of Kells

ALL PINS $8.50
Post paid including members discount

Because these are hand made all designs differ slightly. Only shapes can be specified.

Museum Shop
The American Museum
of Natural History
79th Street and Central Park West
New York, N.Y. 10024

Please send me

	Quantity
A Oval ______	______
B Bird ______	______
C Circle ______	______

I am enclosing ☐ check
☐ money order
for $
Please include applicable sales tax

Name ______
Address ______
City ______
State ______ Zip ______

of Animals (among the Huichol, the Sacred Deer Person or culture hero-trickster, whose horns are both feathers and Grandfather Fire's arrows); the hunter's wife and the others remaining at home as affecting the hunt—all these find echoes in the Old Stone Age of Eurasia. The peyote shaman's musical bow is also very old as a magical instrument.

"Man depends on symbols because he cannot endure a threat to his powers of comprehension," writes Miss Myerhoff in her careful tracing of native meanings. The respect and affection, evidently mutual, with which she treats the Huichol is an earnest of sound field work and makes this charming book ring true.

WESTON LA BARRE
Duke University

WHEN YOU WRITE TO NATURAL HISTORY

about a change of address, renewal of subscription, billing, or any kind of adjustment, send the present address label from the magazine wrapper.

Moving? Please notify 6 weeks in advance.
You can use this form to tell us about a move or order a subscription.

Change of address—attach your address label in the dotted area and fill in your new address below, clip and mail to: Natural History Magazine. Membership Services, Box 6000, Des Moines, Iowa 50306.

A new subscription—Check box and fill in name and address below.

☐ 1 year—$8
☐ 2 years—$15
☐ 3 years—$21

(Add $2 per year
to Canada and other
non-U.S. orders)

Cut your old address label from magazine
wrapper and attach over this area.
Fill in your NEW address below and mail to:
Natural History Magazine
Membership Services Box 6000
Des Moines, Iowa 50306

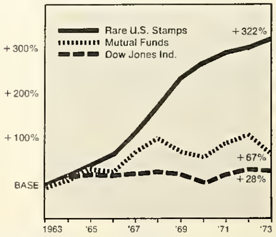
H001

PLEASE PRINT
Name ______
New Address ______
City ______ State ______ Zip ______

10 years ago, these 3 little pieces of paper were valued at $600.

Today, they're worth $3,500!

Since the end of World War II, rare U.S. stamp values have been spiraling up at rates which may be unbelievable to conventional stock market investors. During the past ten years alone, U.S. stamp values have achieved an average annual compounded growth rate of 15.5%!



These impressive increases in value are the result of a rapidly increasing demand for the fixed supply of existing rare U.S. stamps. Since the supply of U.S. stamps produced in the 19th and early 20th centuries can never be increased, this demand can only serve to drive prices even higher.

Now, through our professional new service, you can participate with confidence in the rapidly rising values of rare U.S. stamps—at a total cost which is competitive with the price of the stamps alone in today's market. For an investment of as little as $25—or as much as $500—per month FNI will help you build a rare stamp investment portfolio on a regular monthly basis.

To learn more about this exciting new investment opportunity, mail this today.

1st First National Investors INCORPORATED
257 Riverside Ave., Westport, Conn. 06880

Please send complete information on Rare U.S. Stamp Investments plan. NH 104

Name ______
Street ______
City ______
State ______ Zip ______

Limited to residents of the U.S. and Possessions

©1974 First National Investors, Inc.

Tiffen can help you learn about the birds and the bees.

Tiffen makes compact high quality Hi-Trans® binoculars designed with the outdoorsman in mind. And our unique Roof Prism Optical System is of such fine quality and durability, you'll find them only where fine cameras are sold. And at a price much less than you'd expect.

Ask to see all five models of Tiffen Hi-Trans® binoculars. And from then on, no matter which pair you choose, you can get as close to nature as you want. Write for literature.

Tiffen. The binoculars with camera quality lenses.

TIFFEN
Manufacturing Corp.
75 Jane Street
Roslyn Heights, N.Y. 11577

"URSA MINOR"

from the sterling silver Collector's Menagerie

Height 6" $235.
limited to 150
in solid silver, rosewood base.

Collector's
Menagerie
579 South Poplar Way
Denver, Colorado 80222

Menagerie Catalog—B $1.00

also sold at
Cartier, New York—Pace Ltd. Denver

Continued from page 20

ric and nitric acids. The acidity is in the range of 3 to 4 on the pH scale, sufficient to leach nutrients from leaves and, over a period of years, from soils. Soil scientists recognize that continued leaching with a weak acid will reduce the productivity of agriculture and of other vegetations.

A 10 percent reduction in agricultural productivity is difficult to measure and might be recognizable only over a period of several years. Yet a reduction of that proportion in the productivity of forests and of agriculture in New England seems to be a realistic prediction if acid rains continue for ten years or more. A 10 percent reduction in the net primary productivity of natural vegetation and of agriculture in the New England states would represent a loss of energy equivalent to the power produced by fifteen 1,000-megawatt reactors.

The segments of society that are most closely dependent on natural resources, such as farmers and fishermen, would feel this loss most, but all of us would feel it to some degree. A reduction in the yields of forests and agriculture would raise the prices of all forest products and of food. Effects would extend to estuarine and coastal fisheries as well. This is simply another instance in which the use of nonrenewable resources has been, and continues to be, allowed to destroy renewable resources.

We cannot separate the squeeze on energy used in support of technology from the squeeze on biotic resources; nor can we separate the squeeze on these resources from the growing squeeze on food and the quality of life. Despite the dreams of technologists, the availability of cheap energy has not created new basic resources for human use; instead, the net effect has been a reduction in the net primary productivity of the earth and a concomitant and now soaring increase in the rate of loss of species. These facts taken together suggest that we have reached a point in the development of our current civilization where further increase in flows of energy through technology will cause a significant reduction in the capacity of the earth to support mankind. The world cannot use more energy safely. The arguments for relaxation of controls on pollution or for the further diffusion of the deleterious effects of technology around the globe are clearly and simply wrong. So, too, are the dreams of continued economic growth in the patterns of past decades, using abundant new supplies of energy. We have reached the point where biotic resources are crashing—limits are with us now. Technology may alleviate some of the problems at present rates of energy use, but another doubling of energy consumption in the United States may be impossible—and a worldwide doubling is frightening.

My glistening aluminum capsule—low on fuel, empty of food, its tasteless movie spent—is sinking through the smoke and fog of New York City toward the concrete strip that was formerly part of Jamaica Bay, once one of the largest salt marshes in the world. We have just crossed the Hudson River, passed the towers of Manhattan, and are gradually descending over mile after square mile of brick tenements in Brooklyn. Energy makes this city possible—the same energy and technological genius that produced my plane, plus energy from natural systems, from the green of those irrigated plots in western Nebraska, the green of the forests of New York State's Catskill and Adirondack mountains, the greens and browns and reds of the ocean out beyond Far Rockaway.

The earth's surface—the land and the oceans—is an energy-fixing machine. From this point of view, what is the real cost of this city, measured in total space on a finite globe? No one knows for sure, but the cost reaches far beyond the city or the state or even the entire country to include a large segment of the North Atlantic and a large portion of the atmosphere. It includes, as well, a share of problems that are worldwide in scope—the energy crisis, the use of DDT and other poisons, the control of acid rains, the management of world fisheries and the impending worldwide crisis of biotic impoverishment. The earth is overpopulated and overdeveloped; the important problem now is ecology, not energy and not economics. □

Soaring Spirit

The Eagle Dance

On the fourth and last day of the healing ceremony in the Pueblo of Tesuque (tes-oo-kay) the Eagle Dance is performed. In recent times, the dancers are mostly the older men; the boys become too impatient with the demands of tradition to learn all that is required.

Diving, crouching and making sweeping gestures with their winged arms, this graceful, swooping dance requires incredible control and strength. It is one of the most beautiful and intricate of all Native American sacred dances.

All the white cloud eagles
Lift me up with your wings.
Take me to the entrance to the earth.
All you eagles
Lift me up with your wings.
Lift me high over the world.
Let no one see where you are taking me
far to the southwest
where our mothers and fathers have gone.
Take me there with your wings
Place me there with your wings.

— Pueblo song fragment

With kind permission of the Southwest Museum, Los Angeles.

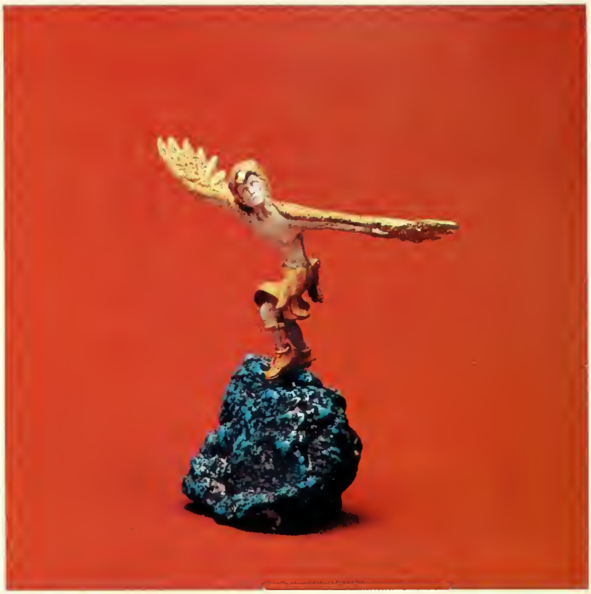
The Artist

To one born in the Indian country of northern Arizona, fascination with Southwestern Indian culture begins at an early age.

For Mikael Redman, imbued with such firsthand knowledge, it became a necessary artistic endeavor to apply the European tradition of superb craftsmanship to capture the mystique of the Original Americans. Thus his miniature sculptures in the lost wax process represent a unique blending of the New World with the Old.

In a demanding medium, he is a demanding artist. Up to six hundred hours of intricate work go into the production of each sculpture. So intricate that one is able to see the fringe on the moccasin of a figure whose overall height is less than two inches, or the tendons of a hand one or two millimeters across!

It is not surprising, then, that Redman Miniatures command prices of up to $8,000, and are found in many public and private collections. Other examples of Redman's sensitive and expressive art can be seen at his gallery at 7110 Fifth Avenue, Scottsdale, Arizona.



cast figure measures 2½" tall.

Turquoise nuggets will vary in size and color.

A Remarkable Opportunity

Turquoise and silver are traditionally utilized by Southwestern Indians in the creation of works of art of surpassing beauty. Even as the scarcity of these materials continues to grow, their beauty further enhances the current revival of interest in Native American culture. What better selection of materials, then, could there be for these unique sculptures?

For whatever reason one acquires a work of art: beautification of one's surroundings, the enrichment and preservation of history, or its value as an investment, a beautiful miniature of this quality will have an important niche in any collection. Purchasers of this piece will have the opportunity to reserve the same Edition Number on subsequent works in the series.

The Mikael Redman Galleries

Scottsdale, Arizona

The Sculpture

"The Eagle Dancer" is the first in a series of eight Southwestern Indian figures by Mikael Redman. There are 885 sculptures in the edition available for sale, with an additional 15 reserved for museum collections. The figure is .999 fine silver, accented with 24 carat gold plate, rhodium-clad to prevent tarnishing and mounted on an uncut turquoise base of at least 250 carats. Presented in a suede-lined, oiled walnut case which may be hung as a shadow box. Individually numbered and signed. $265.00

A signed, numbered edition of twelve will also be offered in four hues of solid 18-carat gold. $3200.00 each.

Ordering Information

These original sculptures are available only through The Mikael Redman Galleries. Address all inquiries to The Mikael Redman Galleries, 7110 Fifth Avenue, Scottsdale, Arizona 85251, attention: Mr. Ryan.

American Express, BankAmericard or Master Charge cardholders may expedite shipment of their purchase by calling Mr. Ryan, toll free, at 1-800-528-7865. Extension 1300

by Stephen P. Maran

Far-out Comet Watching

The Skylab astronauts, circling 270 miles above the earth, had the only good view afforded anyone of Comet Kohoutek

"It's something I know you'll all enjoy," said Edward Gibson about Comet Kohoutek, when talking to ground controllers at the Lyndon B. Johnson Space Center in Houston on New Year's Day, 1974. A civilian scientist-astronaut, Gibson was up in space aboard the earth-orbiting Skylab. Since late November, he and fellow crew members Gerald Carr of the Marine Corps and William Pogue of the Air Force had been studying the comet. As Kohoutek swept to perihelion—its closest approach to the sun at 13,240,000 miles—on December 28, the comet was a spectacular sight for them, although it was almost unobservable from the ground. For watchers down on earth, it was expected that Kohoutek would soon become visible in the evening sky after sunset.

The Skylab astronauts celebrated Christmas 1973 with a walk in space during which they used a special camera to photograph Comet Kohoutek. This picture, taken that day, shows the hydrogen cloud surrounding the comet. The color in the photograph was added to represent different intensity levels of ultraviolet light.

It was possible to see fifteen sunsets a day on Skylab. And Kohoutek was theoretically visible after each of them. Gibson was accordingly offering comet-viewing tips to his friends below. But, like most forecasts about Kohoutek, his were also wrong. In the following week, to the disappointment of millions of expectant watchers, the comet faded rapidly (*see* "A Funny Thing Happened to Comet Kohoutek," *Natural History*, March, 1974). It seemed that the only good way to watch this comet was from a spacecraft orbiting the earth.

Although Kohoutek was a visual disappointment to the lay viewer, it was a rich source of new facts for astronomers. "A scientist's comet," *Sky and Telescope* called it, and a cover story in *Science News*, "Kohoutek's Legacy to Science," noted that "if Kohoutek was a flop, numerous scientists didn't get the message." Photographs and data gathered by this third and final Skylab crew, together with measurements from a host of ground-based observatories, unmanned spacecraft, and jet airplanes, were responsible for the legacy.

In the end, we learned much from Comet Kohoutek because we had the unusually long lead time of almost ten months between its discovery and the time that it reached perihelion. This allowed us to plan observing programs for ground telescopes, automated satellites, sounding rockets, and aircraft, and to devise and test new spacecraft maneuvers and technical objectives for Skylab. With this unparalleled opportunity to prepare experiments, many of the planners looked forward to the coming of Kohoutek with an enthusiasm perhaps second only to that of the eighteenth-century observers who awaited the first predicted return of Halley's comet. Of those would-be Halley watchers, Voltaire is said to have remarked, "Astronomers never went to bed in 1758 for fear of missing the comet."

The Skylab astronauts actually began their comet watch on November 23, six days after the start of their record-breaking 84-day stay in space. Before their mission was over, they had recorded the growth of a huge hydrogen cloud that surrounded Kohoutek as the comet approached the sun; discovered a brilliant "antitail" formed by meteoroid particles shed from the comet's nucleus; and photographed an unusual, tapered tail formation of uncertain chemical composition. In mid-December, they observed a unique event as the head of Kohoutek passed across π Scorpii, a bright star in Scorpius. Later in the month, as the comet streaked by the sun at speeds up to 251,000 miles per hour, they obtained striking pictures of Kohoutek traveling behind the beautiful streamer formations of the outer solar atmosphere.

To study Kohoutek, the astronauts relied on instruments ranging

NASA PHOTOGRAPH, PHOTOPROCESSED INTO COLOR CONTOURS BY ROBERT GOODING OF TECHNICOLOR, INC.

Travel to the Indian Ocean island paradise

Escape to the secluded island world of the Maldives, Laccadives, Andaman and Nicobar archipelagus.

There are more than two thousand unspoiled islands in the Indian Ocean with only a few that are inhabited.

A comfortable palmleaf covered bungalow awaits you there near a beach of ivory coloured sand.

Ideal for amateur botanists, birdwatchers, scuba divers, anthropology enthusiasts, fishing hobbyists, big game sportsmen and those who just want to soak up the sun and put their thoughts together.

...or take a Sahara caravan adventure.

Explore the fascinating stark lunar beauty of the central Sahara by camel caravan and Land Rover. Discover the mountains, the dunes, the oases, the bazaars. Observe the worlds finest natural museum of primitive rock painting in the Tassili N'Ajjer.

Truly a unique experience for all adventure lovers.

Please forward more information regarding your
☐ Indian Ocean island retreats.
☐ Sahara caravan adventure.

Name________________
Address________________
City________________
State________________
Zip Code________________

Office of Academic Liaison
640 Cathcart, Suite 307
Section NHA, Montreal
Canada, H3B 1M3

in sophistication from a simple Nikon camera to various ultraviolet spectrographs and large solar telescopes. The Nikon, aimed through a window in the Skylab command module, was used to make a systematic record of the comet's brightness, free of the obscuring effects of the earth's atmosphere and the vagaries of the weather. From these black-and-white photographs the brightness of the comet was determined relative to the known intensities of background stars, but the task involved surmounting several difficulties. To begin with, stars have various colors and are therefore recorded inconsistently on film, which is more sensitive to the light of some colors than to that of others. Astronomer Charles Lundquist of Marshall Space Flight Center has overcome this problem by basing brightness estimates on stars of the spectral type "G," which are similar in color to the sun. These stars have a spectrum comparable to the head of a comet, which shines primarily by the reflection of sunlight. Another problem was that stars appear essentially as bright points, whereas the image of the comet was an elongated, diffuse surface. How can such different images be compared? The solution adopted was to take two of every three Nikon pictures deliberately out of focus. The blurred images of the stars in these pictures, seen as disks rather than as points, were more easily related to the image of the comet. The Nikon photos are less impressive than those obtained with larger instruments used on the mission, but they provide a basic record of the comet's variable luminosity during a period when conventional, ground-based observations were difficult because the comet was low in the sky.

On November 25, the Skylab crew obtained the first ultraviolet spectrogram ever made of Kohoutek by rolling the spacecraft so that a small on-board spectrograph could view the comet through an unblocked scientific airlock. (The prime airlock was blocked by a heat shield that earlier astronauts installed after a launch mishap.)

By November 28, the comet's tail viewed through binoculars from Skylab had grown to prominence. On the same day, astronomers at Mauna Kea Observatory in Hawaii recorded the spectrum of the comet

SECRETS!

GRAHAM HUNTER
?
?

Trapping secrets, that is! Lots of 'em! . . . They're in that fascinating, unusual book—the HAVAHART Trapping Guide. All about animals and things animals do. It tells how to trap 'em *humanely*, too . . . Price list for fully assembled traps, cages 'n everything included. Send 25c (credited to first order) for this great book. We'd like *you* to get your copy at once. Write for it *today*. Address—

HAVAHART, 158 Water St., Ossining, N. Y. 10562
Please send new guide and price list.

Name________________
Address________________Zip________

FITS ALL 35 mm SLR'S INTERCHANGEABLE LENS HEADS 200, 400, 640 mm ALSO FITS 8 mm, 2¼ x 2¼ & 16 mm

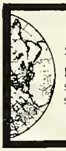
NOVOFLEX WILDLIFE KIT **BROOKS** *NOVOFLEX WILDLIFE KIT*

LETS YOU PUT THE "SQUEEZE" ON YOUR BIRD

USE NO TRIPOD STRICTLY HAND-HELD

DON'T FUMBLE WHILE YOUR BIRD IS FLYING AWAY. WITH NOVOFLEX YOU FOCUS WITH ONE HAND BY SQUEEZING PISTOL GRIP. FOLLOW YOUR BIRD (IN FOCUS) NO MATTER WHERE HE FLIES. FOR COMPLETE DETAILS WRITE:

BURLEIGH BROOKS OPTICS, INC., • 44 BURLEWS CT., HACKENSACK, N.J. • 201-489-1300

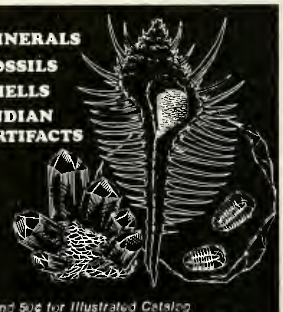


ENCHANTING ISLES of the EAST

A trip unique in the world of travel—to Tana Toradja, "land of the heavenly kings"—to incredible islands of Indonesia, the Philippines and Malaysia. Small select groups. Brochure your agent or

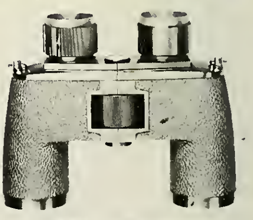
WORLD TRAVEL ASSOCIATES, INC.
219 Palermo Ave. Coral Gables, Fla. 33134

MINERALS
FOSSILS
SHELLS
INDIAN ARTIFACTS



Send 50¢ for Illustrated Catalog

DOVER SCIENTIFIC
Box 6011 C Long Island City, N.Y. 11106



BUSHNELL 7x35 CUSTOM

Mfg. List $139.50 Postpaid $84.50

This is an example of the deep discount prices on high quality optics that is found in our FREE catalog. This catalog lists and illustrates an outstanding selection of camera lens, telephoto lens, telescopes, binoculars etc., plus valuable information on how to properly select them. Write for it today.

GIL HEBARD OPTICS
COURTHOUSE SQ., KNOXVILLE, ILL. 61448

with an 88-inch telescope, and the staff at the new Joint Observatory for Cometary Research on South Baldy Mountain, New Mexico, took their first photograph of Kohoutek. The comet was brightening steadily, and by December 5, the astronauts were watching it with the naked eye. Only a few days earlier the first of several ground-based false alarms had warned that the comet had broken up and disappeared. That rumor, quoting several British observers, was carried by the BBC on December 2 and repeated by them the next day. Similar reports from Belgium and the Netherlands were carried by UPI on December 7. But viewing was better from space than from Europe, and the astronauts continued their work. On December 5, they photographed the comet's growing hydrogen cloud with a special Far Ultraviolet Camera they had taken up to the Skylab with them in the command module.

The Far Ultraviolet Camera is an extremely sensitive device, whose working principles combine both electronic imagery and photography. Developed originally by astronomer George R. Carruthers of the Naval Research Laboratory in Washington, D.C., for use on the airless moon, the camera design had been modified by the addition of a "pressure bottle" that shielded the delicate instrument from the humid atmosphere of the Skylab cabin.

Ultraviolet light from celestial objects cannot penetrate the earth's atmosphere and can therefore only be observed from space. Hence, the existence around comets of huge hydrogen clouds, which shine at the ultraviolet radiation wavelength known as "Lyman-alpha" (after the American physicist Theodore Lyman, who pioneered laboratory studies of ultraviolet light in the first decade of this century), was not discovered until 1969, well into the space age. Since then, satellites have made electronic measurements of the intensity of Lyman-alpha radiation from the comets Bennett, Encke, and Tago-Sato-Kosaka, but only one ultraviolet photograph of a comet had been made before the appearance of Comet Kohoutek. The astronauts made more than 100 exposures of Kohoutek with Carruthers's camera during their Skylab flight; some were taken in the Lyman-alpha wavelength, and others, for comparison, were taken in an

john's island
Only by personally visiting John's Island can one fully appreciate the special ambience of this privately owned resort community of residential properties, golf cottages and oceanfront apartments. The next best thing, however, is our handsome, hard-cover book. It is illustrated with 99 color photographs, and is available for $5. We suggest you write for it: 114 John's Island Drive, Vero Beach, Florida 32960.

john's island

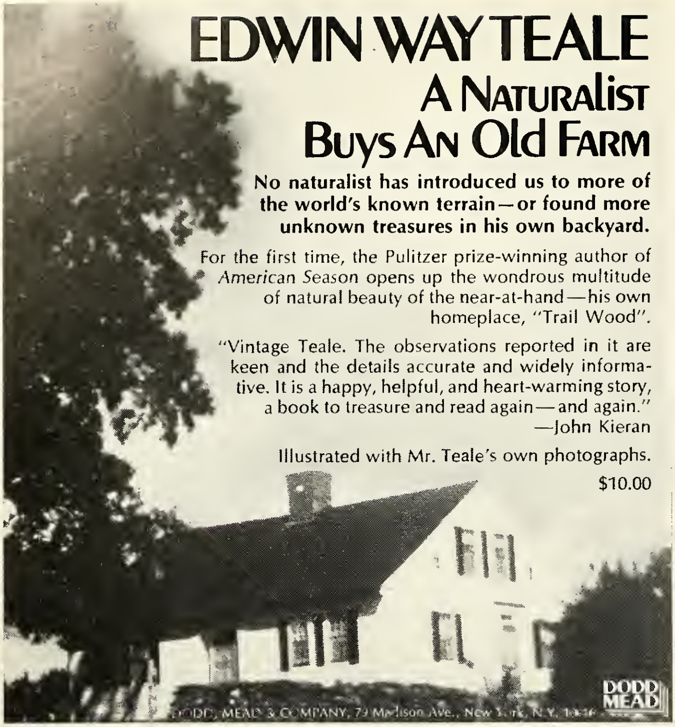
Obtain the HUD Property Report from developer and read it before signing anything. HUD neither approves the merits of the offering nor the value of the property as an investment, if any. This offering is not available to residents of states where prohibited by law.

TRAVEL THE WORLD OF LINDBLAD

JOURNEYS INTO ANTIQUITY

Lars-Eric Lindblad offers three journeys of classic beauty into Egypt's ancient past. You may desire to travel "A Thousand Miles Up The Nile." You may want to explore "The Blue & White Nile," which includes an expedition into Ethiopia. Or you may want to embark on a journey to "Lands Of Antiquity" which, in addition to Egypt, will take you to Greece and some of its historic islands. These three tours feature unique and exciting excursions into unrivaled archeological places. You will marvel at the sight of great temples and relics of true antiquity. Write for our informative brochure or see your travel agent.

LINDBLAD TRAVEL, INC.
Dept. NHN1074
133 East 55th St., New York, N.Y. 10022
(212) 751-2300



EDWIN WAY TEALE
A NATURALIST
BUYS AN OLD FARM

No naturalist has introduced us to more of the world's known terrain—or found more unknown treasures in his own backyard.

For the first time, the Pulitzer prize-winning author of *American Season* opens up the wondrous multitude of natural beauty of the near-at-hand—his own homeplace, "Trail Wood".

"Vintage Teale. The observations reported in it are keen and the details accurate and widely informative. It is a happy, helpful, and heart-warming story, a book to treasure and read again—and again."
—John Kieran

Illustrated with Mr. Teale's own photographs.
$10.00

DODD, MEAD & COMPANY, 79 Madison Ave., New York, N.Y. 10016

DODD MEAD

America's Most Honored Artist/Naturalist

Roger Tory Peterson

"The most successful owl in the New World is definitely the Great Horned which has spread its dominion from the edge of the sub-Arctic tundra to the bleak slopes of Tierra del Fuego. Wildest of all birds it has, at the same time, come to terms with man and even nests at the edges of some large cities."

Roger Tory Peterson

GREAT HORNED OWL

Signed and Numbered
Limited Edition: 750
Overall Print Size: 29½" x 21"
All rag imported paper.
Retail Price: **$150.00**

Write for free literature on additional subjects and information about our Collector's Payment Plan. Limited Edition art prints from $50 to $300 by James Boren, John Clymer, Roger Tory Peterson, Maynard Reece and Melvin C. Warren.

Mill Pond Press
Dept. NH10-651
204 S. Nassau Street / Venice, Florida 33595
Phone 813/485-8811

Dealer Inquiries Welcomed

© Roger Tory Peterson 1974

adjacent ultraviolet wavelength band, where emission from the comet's oxygen atoms was expected. One of the latter photographs, made on December 25, shows the comet with a strange, tapered tail and is among the most interesting of all the pictures taken of Kohoutek with any telescope or camera. Astronomers are still puzzling over its meaning. In this picture, the comet is widest at the head (about 300,000 miles wide, according to astronomer Thornton Page of the Naval Research Laboratory, principal investigator for the Far Ultraviolet Camera studies) and tapers down to a point more than a million miles away in the direction opposite the sun. At a special session on Kohoutek results, held during the meeting of the American Geophysical Union in Washington, D.C., last April, Carruthers reported that the tail length exceeded that theoretically possible for oxygen atoms streaming back from the comet's head. The tapered tail might actually be composed of ionized, or electrically charged, carbon atoms, he suggested. The behavior of an ionized comet tail in the solar wind is much like that of an airport wind sock exposed to a steady breeze. Thus, if Carruthers's idea is correct, the December 25 picture may contain unique data on the solar wind near the sun. John C. Brandt, an astrophysicist at the Goddard Space Flight Center, who wrote the standard treatise "Introduction to the Solar Wind," says that analysis of this photograph may eventually reveal the approximate velocity of the solar wind at the position then occupied by the comet—17 million miles from the sun—much closer than the site of any previous measurement. Investigator Page has advanced an alternative to the oxygen and ionized carbon theories to explain the nature of the tapered tail. He thinks it may have been composed of dust particles, shining by reflection of the sun's ultraviolet light. If Page's idea is correct, I would have expected the tail to be dimmer and more diffuse than it appeared. At this juncture one can only say that the correct interpretation is far from obvious.

The astronauts made their first ultraviolet photograph of Kohoutek with Carruthers's camera through an airlock on November 26. On that picture the circular image of the hydrogen cloud corresponded to a diameter of 65,000 miles. As the comet neared the sun, a series of photographs, measured by Page, shows the cloud getting bigger and brighter. In a December 25 photograph, the hydrogen cloud is some 1,200,000 miles in diameter, or nearly half again as large as the visible disk of the sun. Actually, theory indicated—and data from Mariner 10 instruments later corroborated—that the thinner regions of the cloud extended over an even greater region. The full area of the cloud could not, however, be recorded because Skylab, while outside the great bulk of our atmosphere, was still inside the geocorona, a tenuous hydrogen cloud that surrounds the earth. And the dim ultraviolet radiation of the geocorona outshone the thinner parts of Kohoutek's cloud. In mid-January, when it was possible to scan the receding comet from outside the geocorona with an instrument aboard the deep space probe Mariner 10, bound for Venus and Mercury, physicist Shailandra Kumar of the Kitt Peak National Observatory in Tucson, Arizona, reported that the cloud extended more than 18 million miles from the head of the comet, in the direction opposite the sun. Later, in January and February, astronomer Jerry Drake of Princeton University obtained additional hydrogen light measurements with the unmanned Copernicus satellite. Only Skylab, however, was in a position to record with Carruthers's camera the growth of the hydrogen cloud as Kohoutek approached the sun.

The small spectrograph with which the astronauts made their first ultraviolet spectrogram of the comet was also used at intervals throughout the flight to record the distribution of hydroxyl (OH) molecules around it. Chemically, a hydroxyl group is relatively unstable. It cannot therefore be a permanent constituent of a comet. The great cloud of hydrogen around a comet is also somewhat puzzling at first thought. The hydrogen atoms do not remain in the cloud, but escape from the comet at speeds of about five miles per second, a velocity confirmed by measurements with a larger spectrograph on Skylab. Scientists generally believe that the hydrogen gas is not simply evaporating from frozen hydrogen in the co-

You can hear the quality of this vintage Bracket Clock every quarter hour: the pure tones of its Westminster Chimes are enhanced by the rich resonance of thick solid native black walnut in a case assembled with cabinet-maker precision. Your descendants will rely on it as confidently as you will! Lasting accuracy is ensured by a genuine Erhad Jauch 8-day keywind movement of solid brass and nickeled steel, with jeweled escapement and chimes that automatically synchronize to the hands. Solid brass dial has silvered hour ring.

Sold subject to your approval after using 30 days. (If you are not well pleased, return clock for full refund.)

$179 delivered.
Check, BankAmericard or Master Charge.
Ala. res. add 4% tax.

Do-It-yourself kit **$119**
complete with dial, assembled movement, chimes and hardware. Door assembled, other wood parts cut and sanded.

Brochure on request.

CROWN CLOCK CO.
P.O. Drawer G-19, Fairhope, Ala. 36532

TRAVEL THE WORLD OF LINDBLAD

We are pleased to announce the

M.S. LINDBLAD EXPLORER'S*

exciting 1975 Cruising Program taking us through the waters of seldom-seen parts of our oceans.

The Amazonas to Dakar
March 4—28
From the Senegal to the Nile
March 27—April 25
Black Sea—Cruise A
April 18—May 21
Black Sea—Cruise B
May 16—June 18
Baltic
June 16—July 19
The Arctic Adventure 1975
July 15—August 19
British Isles and Faroe Islands
August 28—September 25
Amazon Upstream
September 24—October 24
Amazon Downstream
October 31—November 28

Please write for our cruising expeditions program for 1975, or see your travel agent.

LINDBLAD TRAVEL, INC
Dept. NHME1074
133 East 55th Street, New York, N.Y. 10022 (212) 751-2300

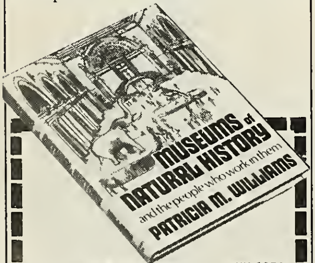
*Panamanian registry

The inside story of how museums work.

"An excellent means of informing young people of the variety of careers available in museums...Drawing on twelve years of professional experience at Field Museum, the author has created a concise, nontechnical, and humanistic picture of museum people, past and present."
—*Field Museum Bulletin*

For the youngster thinking about a museum career, or for the dedicated museum goer of any age, this exciting book makes an ideal gift. Use the handy coupon below to order.

MUSEUMS OF NATURAL HISTORY AND THE PEOPLE WHO WORK IN THEM
Patricia M. Williams
Contains state-by-state listing of museums.
Illustrated with photographs.
$5.95 at all bookstores or from the publisher direct.



ST. MARTIN'S PRESS NH-1074
175 Fifth Avenue, New York, N.Y. 10010
Send me, postage paid, ______ copy(ies) of MUSEUMS OF NATURAL HISTORY @ $5.95 each. I enclose $______ ☐ check ☐ m.o.
Name ______
Address ______
City ______
State ______ Zip ______

met's nucleus since, most likely, solid hydrogen cannot exist there.

The origin of both the OH and the hydrogen (H) is attributed instead to the breakup of water (H_2O). According to the "dirty iceball" theory of comets, proposed by astronomer Fred L. Whipple of the Smithsonian Astrophysical Observatory in Cambridge, Massachusetts, much of the nucleus of a comet is simply frozen water. As the ice evaporates in response to heat from the sun, the water molecules stream out into the head of the comet, where solar radiation breaks them up into H and OH. Still another breakdown product, H_2O^+, the water vapor ion, was discovered in the tail of Kohoutek by ground-based astronomers in Italy and California, with help from physicists in Canada.

As the comet neared the sun in late December, the Skylab crew began to observe it with their battery of solar telescopes. On December 23, Gibson watched Kohoutek on the TV monitor of one telescope and noted that it appeared about as bright as the planet Mercury. The next day, Carr reported that the comet's head was growing larger and brighter. A distinct yellow color was now evident. It is thought that this was due not simply to reflected sunlight but also to yellow light from sodium atoms in the head of the comet. (This is the familiar yellow hue seen when salt—sodium chloride—is dropped into a fire.) On Kitt Peak in Arizona, geophysicist Louis Lanzerotti of Bell Laboratories obtained spectrograms of Kohoutek that confirmed the presence of sodium. Gibson states that an orange color, quite distinct from the yellow, was seen on only one day, December 30. There is no accepted explanation for the one-time appearance of this shade.

On Christmas Day, Pogue and Carr took a walk in space to observe the comet with the Far Ultraviolet Camera outside the confines of Skylab. The comet was by then too close to the sun to be photographed from the spacecraft airlock. They mounted the instrument on an external spar, in the shadow of a solar power panel. Following instructions from Houston, they successfully aimed the camera at Kohoutek, just off the edge of the protruding panel, which served to keep the sun's rays from falling on

POSTERS OF THE PAST
1,000 fascinating posters and handbills of 18th and 19th centuries. Reproduced from originals, tracing America's social and political history. Unusual, decorative, informative. Most under $1. Send 25¢ for complete catalog.
BUCK HILL ASSOCIATES
Dept. NH Garnet Lake Rd., Johnsburg, N.Y. 12843

SOUTH INDIA – BURMA – CEYLON
To great sites, cities and peoples of South India, Eden Isle Ceylon with its temples and scenic grandeur, to Burma, Rangoon, Mandalay and the archaelogical trove at Pagan. Brochure your agent or
WORLD TRAVEL ASSOCIATES, INC.
219 Palermo Ave. Coral Gables, Fla. 33134

Complete Book of HEATING WITH WOOD
You can fight rising home heating costs and still keep warm this winter! Learn STARTLING NEW INFORMATION here: price per cord you can afford to pay and still SAVE over fuel; which soft woods are better than hard woods; there is enough waste wood in the U.S. to heat all homes by wood, and actually improve forest stands; new data on wood heat thermal values and conversion capabilities in PRACTICAL TERMS FOR THE HOME OWNER: chain saw, tool handling; Felling, Hauling, Storing, Splitting, Stacking; safe stove, chimney location and care; thorough description and evaluation of all major heating devices and stoves. All this and more — for sure savings, you need this book NOW! 128 pp., quality paperback, $3.00. From: **GARDEN WAY PUBLISHING, Dept. B-3560, Charlotte, Vermont 05445**

BOOK HUNTING?
Virtually any book located—no matter how old or long out-of-print. Fiction, nonfiction. All authors, subjects. Name the book—we'll find it! (Title alone is sufficient.) Inquire, please. Write: Dept. 65.
BOOKS-ON-FILE
UNION CITY, NEW JERSEY 07087

Bean's *Outdoor Sporting Specialties*
Free Fall Catalog
Just Off the Press

L. L. Bean, Inc.
Fall 1974

Fully illustrated featuring hunting, winter sports and camping equipment. Outdoors apparel and footwear for men and women. Many items of our own manufacture. Our 62nd year of providing dependable, high grade sporting specialties. All fully guaranteed.
☐ Send Free Catalog
Name ______
Address ______
Zip ______
L. L. Bean, Inc.
622 Main St., Freeport, Maine 04032

the lens. According to Space Center tapes, the astronauts did not actually notice the comet as they worked that day. But during the next extravehicular activity, on December 29, Carr and Gibson both saw the comet, and Gibson even glimpsed its remarkable antitail through the dark sun visor of his space helmet.

In October, shortly before they entered prelaunch quarantine, the crew had been briefed on cometary phenomena. The principal tutor was Freeman D. Miller, a University of Michigan astronomy professor, who has devoted much of his career to the observation of comets. Among the many topics that Miller discussed was the occasional appearance of an antitail, or "spike," a structure that seems to point toward the sun from the head of a comet. This is the reverse of the behavior of a normal tail, which points approximately in the direction away from the sun. This tendency of the normal tail was known to some men as long ago as the first century A.D. and was mentioned in Seneca's *Quaestiones Naturales.*

Only the astronauts saw Kohoutek's brilliant sunward spike with the naked eye. Astronomer Edward P. Ney of the University of Minnesota scanned it with an infrared telescope several hours after the astronauts discovered it in late December. And in January, the antitail, now shorter and fainter, was photographed at many observatories. Zdenek Sekanina, a leading authority on comet tails at the Smithsonian Astrophysical Observatory, had predicted that Kohoutek would have an antitail visible at about the New Year. (This was apparently the first time the period of visibility of a comet antitail had been successfully predicted.) Sekanina's analysis of the astronauts' observations shows that Kohoutek's antitail consisted of particles up to one twenty-fifth of an inch in diameter, much larger than the microscopic dust of the ordinary tail. Ney's measurements show that the antitail particles were also cooler than those in the main tail.

Why were the cometary particles larger in the antitail than in the ordinary tail? These tiny bits of rock, carried away from the nucleus of the comet by evaporating gases, were subjected to solar gravity, which tended to pull them toward

CARPETS NEED A DOCTOR?

Symptoms:
- SICKLY COLOR
- HARDENED FLATTENED PILE
- LARGE SHADOWS LURKING BELOW THE SURFACE
- SPOTS BEFORE YOUR EYES

Diagnosis:
THEY'VE BEEN GOBBLING TOO MUCH GOOK!
Whether you have been feeding them wet or dry foam—with no way to get out more than 5 to 10% of either it or the dirt—they can soon get filled up and look mighty peu-trid.

Rx: THEY NEED ARGOSHEEN® FAST

Put it down and let it work. Then take up the thick black sludge by the barrels on your cotton pads or your Argomop—because no vacuum ever made can do it. Guaranteed safe for all fibres. Delta Air Lines say they have never found a spot ARGOSHEEN would not remove!

Instant Recovery:
• NEW COLOR • NEW TEXTURE • NO SPOTS • NO SHRINKING • NO FADING

THEN KEEP YOUR CARPET LOOKING NEW WITH LESS EFFORT THAN VACUUMING. IF YOUR CARPET'S NEW—START YOUR ARGOSHEEN PROGRAM NOW!

Write for information including tests which allow you to prove to yourself that no shampoo can mix with the soil and dry to a powder which a vacuum can remove: how to prove whether a cleaner is safe before using it; and how to avoid rapid resoiling. Also included are tips for cleaning some of the new carpets with severe soil-release problems.
Two quarts of ARGOSHEEN with its all-purpose spotters will clean more carpets than a gallon of any other known carpet cleaner. For guaranteed to please prepaid shipment, send check with order: Gallon ARGOSHEEN $8.98; Quart $3.80; 20 oz. Aerosol $3.90; ARGO Rug Mop $5.95. Tub $1.50 or Special 2 Quarts, Mop & Tub $12.50. Dept. NH, ARGO & COMPANY, INC., P.O. Drawer 2747, 182 Ezell St., Spartanburg, S.C. 29302.

Ask For Argosheen From Your Favorite Interior Designer Or Carpet Store

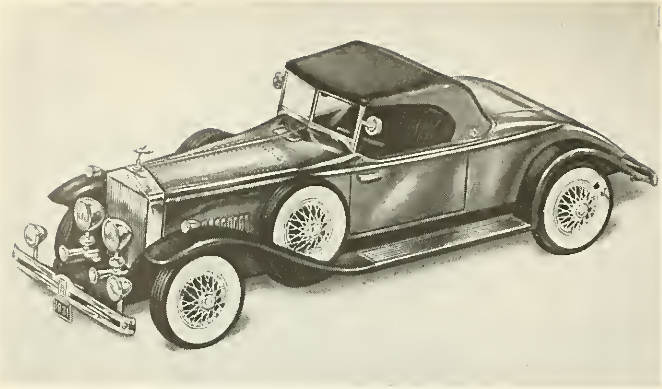
TRAVEL THE WORLD OF LINDBLAD

Journeys into hidden worlds with

LINDBLAD IN SOUTH AMERICA

Lars-Eric Lindblad invites you on journeys to the great continent of South America. Here you may visit some of the most scenic areas in the world. Ethnically and culturally they are also very exciting. For it was here that the proud and peace-loving civilization of the Incas spread their empire from shore to shore. And on Easter Island a pre-historic people erected huge stone statues that even today puzzle anthropologists. Seek out and witness the achievements of these amazing cultures. Perhaps you want to explore the headwaters of the mighty Amazon or visit Tierra del Fuego on an incredible Nature Tour. All of these expeditions are fully described in our "Lindblad in South America" brochure. Write for it today or see your travel agent.

LINDBLAD TRAVEL, INC.
Dept NHSA1074
133 East 55th Street, New York, N Y 10022
(212) 751-2300



Now you can own a

ROLLS ROYCE

with built-in radio

This handsome replica of the famous Rolls Royce Phantom II will soon be a collector's item. Every detail reproduced perfectly, with real rubber tires and wire spoke wheels. All metal body 9¾" x 3¼". Built-in solid state radio operates on its own battery (included). Full refund if not perfectly delighted. Please add $1.00 for postage and insurance. (Ill. residents add 5% Sales Tax).

$19.95

ELECTRONICS INTERNATIONAL, 210 S. Desplaines St., Chicago, Ill. 60606

☐ How many? I enclose $______ RRB-30 (Find above your name)
☐ Master Chge Acct. No. ______ Inter. Bank No. ______
☐ Bk. Americard ☐ Am. Exp. Acct. No. ______ Good Thru ______
NAME ______ ADDRESS ______
CITY ______ STATE ______ ZIP ______

Canadian orders same price. Includes duty.

FREE RECORD OR CASSETTE!

Learn how to speak a second language.

Send for a free Linguaphone recording—it will show you how quickly and easily you can learn a new language. First you listen. Then you understand. And before you know it, you'll be speaking. It's the same natural method you used as a child to learn English. Hearing is believing. So send for your free recording now. There is no charge, no obligation. You have nothing to lose—and a whole new language to gain.

The secret of learning a language.
SAMPLE CASSETTE

Linguaphone Institute, Inc. Dept. NHAX1
100 Park Avenue, New York, N.Y. 10017

I want to learn a new language in my own home. Rush my FREE record or cassette, as I've indicated, plus an illustrated folder that gives a complete explanation. I understand I will be under no obligation.

Please mark appropriate boxes
☐ phonograph record or ☐ cassette
☐ Mr.
☐ Mrs. ______
☐ Ms
Address ______
City ______
State ______ Zip ______
I am most interested in
☐ French ☐ Spanish ☐ Italian ☐ German
☐ Hebrew ☐ Other ______

Linguaphone for Languages

A Service of Westinghouse Learning Corporation

the sun, and to the pressure of sunlight, which acted in the opposite direction. Among the lighter particles, sunlight prevailed, pushing them outward into the main tail that pointed away from the sun. The heavier particles, however, were less affected by radiation pressure, and they drifted back, along or near the comet's orbit, where they made up the antitail. The antitail material was not actually streaming directly toward the sun; it only looked that way because of the perspective of the astronauts and the ground-based observatories relative to the comet and the sun.

We know that many meteoroids—the small rocks from interplanetary space that appear as "shooting stars" when they enter the earth's atmosphere at high speed—must result from the breakup of comets, since meteoroid streams have actually been found following the orbits of certain comets that have vanished. At the Comet Kohoutek Workshop in Huntsville, Alabama, last June, astronomer G. Allen Gary of the Marshall Space Flight Center noted that what the astronauts observed in late December as Kohoutek's antitail was actually a stream of tiny meteoroids freshly shed from the comet.

In April, 1974, comet expert Elizabeth Roemer of the University of Arizona found that Kohoutek was even dimmer than expected from the postfizzle predictions. By the time you read this, the comet will be only a dim spot of light on photographs made with even the largest telescopes on earth. However, as scientists continue to analyze the Skylab observations and the large body of data collected in the worldwide effort astronomers focused on this comet, they will generate a much clearer idea of what these strange and wonderful interplanetary visitors are. From that knowledge we can perhaps proceed to plan a mission that already excites the imagination of many scientists—the launch of a space probe to a comet.

Stephen P. Maran was manager of NASA's Operation Kohoutek. An astronomer, he is head of the Advanced Systems and Ground Observations Branch of the Laboratory for Solar Physics and Astrophysics at the Goddard Space Flight Center, Greenbelt, Maryland.

Smith-Corona ushers typewriters into

The Cartridge Age.

SCM SMITH-CORONA
Coronamatic
TOUCH
on/off
Coronamatic
Coronamatic
CARTRIDGE by SMITH-CORONA
BLUE
SCM
Coronamatic
CARTRIDGE by SMITH-CORONA
SCM
University

With the cartridge you can change to a fresh ribbon in just 3 seconds.

With the cartridge you can change to a color ribbon in just 3 seconds.

With the cartridge you can change to a correction ribbon in just 3 seconds.

The most significant advance in typewriters since the electrics came along has come along. Smith-Corona Electric Portable Cartridge Ribbon Typewriters.

If you had one right now, you could change from one typewriter ribbon to another faster than you could read this sentence.

In 3 seconds you could change from a worn ribbon to a fresh ribbon.

In 3 seconds you could change from a black ribbon to a red, or green, or blue ribbon…there are five different Smith-Corona color ribbons in cartridges.

In 3 seconds you could change from an ordinary fabric ribbon to a carbon film ribbon. (That's the one students like to use for essays and reports. It makes typewriting look like professional printing.)

In 3 seconds you could change to a correction ribbon that allows you to correct errors more neatly and with less effort than ever before.

If you've been thinking about a new typewriter as a back-to-school gift, or for yourself, or for anyone… see what we've been talking about. Ask a Smith-Corona dealer for a demonstration of our unique Cartridge Ribbon Typewriter.

SCM® SMITH-CORONA
SCM CORPORATION

One Man's Meat is Another's Person

Humans may taste good, but most societies are a long way from cannibalism

Of all the taboos in Western society, the prohibition against the eating of human flesh is the most widely obeyed. Thousands among us kill someone every year. Incest is not common, yet it occurs—and enriches the fantasy life of many an analysand. But cannibalism is an infraction of the social order that very few have risked.

Like all forbidden fruits, nevertheless, cannibalism fascinates us. Ever since Columbus first discovered it among the Caribs (who were called *canibales*, whence the name), it has inspired an entire literature of speculation and raised a dark question in the minds of people too civilized to feel anything but repulsion at the idea of bolting human steaks but unable to keep from wondering in untrammeled moments what they taste like.

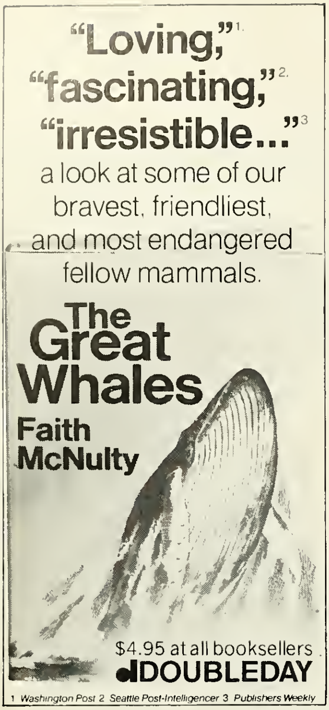
Explorers, probably translating a Fijian phrase, reported that the stuff was known to its fanciers in the Pacific as "long pig." This never seemed more than a dubious description of the savor of our muscular Christian selves. The enigma basically remained until late 1972. Survivors of a Uruguayan plane crash in the Andes, who were cut off from the outside world for weeks, in desperation ate fellow passengers killed in the accident. After their rescue, the survivors told Piers Paul Read—who set down their story in the current best-seller *Alive* (Lippincott)—that after cooking the meat briefly (they tried it first raw), "the slight browning of the flesh gave it an immeasurably better flavor—softer than beef but with much the same taste."

That is the kind of testimony one can believe, especially from Uruguayans, who know their beef. It is also good news that humans taste good: alternatives to soyburgers are always welcome, and we can at last exonerate cannibal societies of the charge of unrefined savagery. Instead, they were gastronomes.

I anticipate the retort that the anthropophagic banquets of Fiji and Papua and the Amazon began with the butchery of neighboring tribes. But who are we, with our kill ratios and My Lais, to question the civility of, say, Tupinambá warriors? To begin with, they captured prisoners live, led them back through the great forest of the Amazon, and then allowed them to live for months in virtual freedom until the final blood rite. Prisoners were given wives, and thus shared their genes with the victorious village before they gave up their bodies in a ceremonial war game that they were doomed to lose. The quartered body, according to an eyewitness account, was barbecued. Women and children rushed to drink the blood. Mothers smeared their nipples with it so that their babies could taste it. Delicacies, wrote anthropologist Alfred Métraux, such as fingers and the grease around the liver and heart, were given to distinguished guests.

Ethnographers have advanced several theories to explain such full-blown bloodthirstiness. Some say that meat hunger caused it, a craving brought on by poor, monotonous diets of manioc or sago. This won't entirely wash. Contiguous tribes with equally drab and deficient diets did not practice cannibalism. And the Tupinambás, who had plenty of nonhuman protein in their diet, ate slain enemies primarily as a form of revenge.

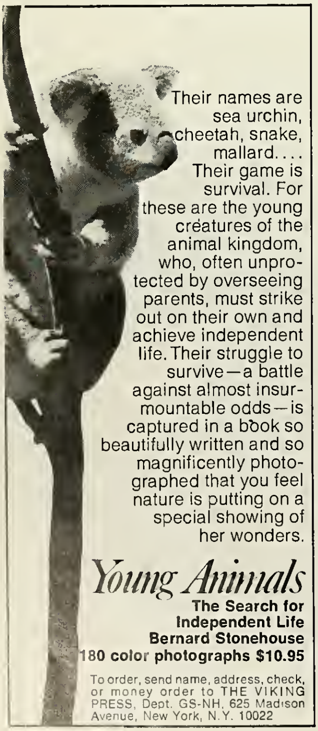
Other experts point to the ritual content of most cannibal acts. For the Tupinambás, the ceremony associated with cannibalism was so important that after cannibalism was effectively outlawed, the ritual continued to be performed on skeletons exhumed for the purpose. In the northwestern Amazon area,


"Loving,"[1] "fascinating,"[2] "irresistible..."[3]
a look at some of our bravest, friendliest, and most endangered fellow mammals.

The Great Whales
Faith McNulty

$4.95 at all booksellers
DOUBLEDAY

1 Washington Post 2 Seattle Post-Intelligencer 3 Publishers Weekly


Their names are sea urchin, cheetah, snake, mallard.... Their game is survival. For these are the young creatures of the animal kingdom, who, often unprotected by overseeing parents, must strike out on their own and achieve independent life. Their struggle to survive—a battle against almost insurmountable odds—is captured in a book so beautifully written and so magnificently photographed that you feel nature is putting on a special showing of her wonders.

Young Animals
The Search for Independent Life
Bernard Stonehouse
180 color photographs $10.95

To order, send name, address, check, or money order to THE VIKING PRESS, Dept. GS-NH, 625 Madison Avenue, New York, N.Y. 10022

by Raymond Sokolov

Cubeo warriors' wives ate the penis of a dead victim to promote fertility. And several endocannibalistic societies recycled the souls of their own villagers by drinking the ashes of naturally deceased relatives dissolved in corn beer or a banana drink.

Endocannibalism—whether practiced by primitives or by Uruguayan rugby players—is less shocking than exocannibalism because it does not normally include murder. But the simple act of consuming human flesh, even when enshrined in ritual, is obnoxious to most people (although excusable *in extremis*). It seems to arise from a fundamental sense of solidarity with one's species. Even higher primates do not (with rare and ambiguous exceptions) eat each other. It may be that exocannibalism results from a narrow system of taxonomy that limits the nonedible "species" group to the kinship group and defines unrelated human outsiders as fair game. Clearly, no all-encompassing principle of human brotherhood informed the daily life of the Tupinambás.

The real difference between us and the Tupinambás, however, is that we are more adept at making our cannibalistic acts and impulses into metaphor or else hiding them from view. We certainly enjoy the fruits of warfare, not in the form of flesh, but as territory, wealth, or influence. Moreover, Christianity's most fundamental ritual, the Eucharist, is symbolic endocannibalism; the consumption of the body and blood of "Our Father's Son." Orthodoxy denies that communion is only symbolic eating and claims that the sacramental wine and wafer do actually transsubstantiate into Christ's flesh and blood in the mouths of the faithful. True cannibals are less "civilized" only in degree.

Discover an alien world

Twelve times annually our tours probe the strange world "Down Under." There you can examine the intriguing natural and cultural phenomena of Australia, New Guinea, New Zealand. These tours are recommended for the intellectually curious traveller who wishes to return home with a comprehensive experience of the antipodal world; geographic scene and natural history, peoples and their past and present cultures.

Please send more details regarding your tours to Australia, New Zealand, New Guinea

Office of Academic Liaison
640 Cathcart, Suite 307
Section NHC, Montreal
Canada, H3B 1M3

Name__________
Address__________
City__________
State__________
Zip Code__________

Electric Potter's Wheel

Create your own ceramics with this unique, remarkably-priced bench-top potter's wheel that you and your family can have fun with anywhere in the house. Variable-speed drive adjusts faster for forming, slower for decorating. Comes with double-end shaping tools, non-toxic glaze and 4 water-soluble paints, artist's brush, potter's sponge, 3 lbs. air-dry clay and illustrated instructions for forming vases, pitchers, candlesticks plus design ideas to bring out the creative genius in you and your kids. No baking or firing required. Send check or money order to Kristi's, Inc., P.O. Box 357g, Maugansville, Md. 21767.

POTTERYCRAFT™ by GILBERT®

$39.95
plus $3.00 Post. & Hdlg. in continental U.S.

Want a good looking, thoughtful, lively, and under-ten-dollar Christmas gift?

You're holding it in your hand right now.

Part of it, that is. For your gift of a one-year subscription to Natural History includes Associate Membership in The American Museum of Natural History (where admission is free to members) ...as well as two specially selected bonus books a year.

What's more, if you mail the order card* today, the price for this many-sided, many-splendored Christmas gift is not just under ten dollars. It's two for $15!

Don't wait another minute.

NATURAL HISTORY
published by
The American Museum of Natural History
New York, N.Y

*If someone's already made off with the card, just write
NATURAL HISTORY, P.O. Box 5000, Des Moines, Iowa 50306.
Give us your name and address; tell us where the gifts
should be sent (including zip codes, please)
and how you want your gift cards signed
Send your check with the order ($8 for the first gift,
$7 each for all others)...or, if you prefer,
just instruct us to bill you later.

I want to give Natural History for Christmas

Enter my gift (a one-year Associate Membership in The American Museum of Natural History and 10 issues of Natural History magazine) for the people listed below. **Bill me later at $8 for the first gift, $7 for each additional gift.**

SEND GIFT TO: ☐ NEW ☐ RENEWAL

NAME

ADDRESS

CITY STATE ZIP

SIGN GIFT CARD FROM:

SEND GIFT TO: ☐ NEW ☐ RENEWAL

NAME

ADDRESS

CITY STATE ZIP

SIGN GIFT CARD FROM

MY NAME

ADDRESS

CITY STATE ZIP

And That's Not All

With their membership and subscription, my friends will also receive two bonus books (special members' editions); free admission to the Museum; use of the Members' Reception Lounge and a discount in the Museum Shop.

NATURAL HISTORY

Outside U.S.A., please add $2.00 per year for postage.

J125

FIRST CLASS
PERMIT NO. 4946
DES MOINES, IOWA

BUSINESS REPLY MAIL

No Postage Stamp Necessary if Mailed in the United States

POSTAGE WILL BE PAID BY—

NATURAL HISTORY
P. O. Box 5000
Des Moines, Iowa 50306

The best ethnographic information, as a matter of fact, shows that cannibalism was not practiced by men at a low level of subsistence but rather arose after the invention of agriculture and the intensification of warfare that followed it.

In our society, we have moved beyond the agricultural-tribal stage, into something we are pleased to call advanced civilization. From this lofty vantage, we shudder at the "bestial" conditions from which we have risen. We instill the fear of cannibalism in our children with tales of "Jack and the Beanstalk" and "Hansel and Gretel." Adult squeamishness extends to include both cannibalism and the eating of nonhuman flesh. For Americans particularly, food that still looks like the animal it came from is often cause for (irrational) disgust. Whole fish, live lobsters, sides of beef on hooks all inspire distaste in people who will blithely eat a slab of steak (it is no longer recognizably lopped from a steer, but the national meat hunger supports giant abattoirs in which wholesale slaughter takes place). Unfortunately, organ meats cannot be so easily disguised. Brains look, almost inevitably, like brains. The sight of those convoluted lobes forces us to admit that we are about to dine on mammal. And so we prefer less obvious cuts. Unlike the Tupinambás, we hide from our killing.

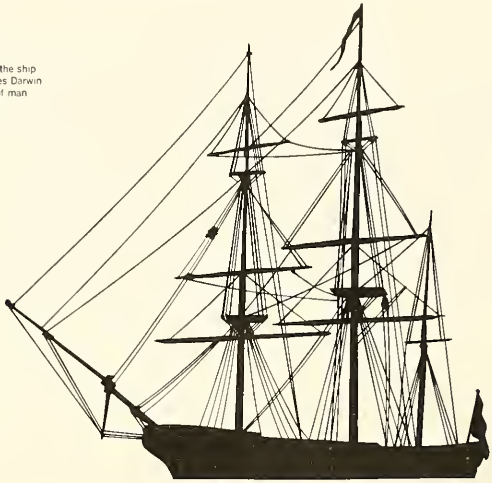
The recipe below takes account of this propensity. It is a supercivilized approach to brains, something like a soufflé but sturdier. It has the great practical advantage of looking like something else. Serve it to picky eaters, who may then be persuaded to try simpler, more obviously cannibalistic recipes for this rich and foolishly avoided food.

Pain de Cervelle

1½ pounds brains (from any higher mammal)
Vinegar
Salt
½ pound whole, unshelled shrimp
½ cup dry white wine
¼ cup raw rice
2 cups milk
Butter
½ cup heavy cream
3 eggs
¼ teaspoon pepper
½ teaspoon paprika

Follow in Darwin's Wake

For Museum members, cruising from Tierra del Fuego to Rio can be a memorable vacation and a chance to see and learn what inspired one of mankind's "great leaps forward"



H.M.S. Beagle, the ship that took Charles Darwin to a new view of man and his origins.

Darwin sailed to Tierra del Fuego and the east coast of South America to see and study the wildlife. Now, we're going to take 85 Museum members to retrace his route, cruising on the celebrated M.S. Lindblad Explorer. Along the way, Dr. Junius B. Bird, Curator Emeritus of South American Archeology, will outline the prehistory of the area and take us to some of the sites he has explored for The American Museum. Dr. Roger Payne and Roger Tory Petersen will also accompany us to make sure we see and understand the fascinating marine life and the unique birds of Patagonia. Logistics are under the supervision of the well-known travel planner Lars Eric Lindblad; the program is the Museum's.

Scheduled for February 17–March 6, 1975, this is the first voyage in the Museum's Membership Tour Program for 1975. We have also tentatively planned an expedition to southern Africa for September 1975, and a third trip will soon be announced.

Mail the coupon below for further details.

Mrs. Philip Martin
Tours for Members
The American Museum of Natural History
Central Park West at 79th Street
New York, New York 10024

Please send:
☐ The Darwin Itinerary ☐ Information about other Museum-sponsored trips in 1975.

Name ______________________________

Address ______________________________

City ______________________ ZIP ____________

Share the Thrills of Exploring Outer Space!

$229.95 f.o.b. Hartford, Conn.

$15 Crating Charge

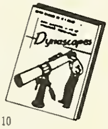
All DYNASCOPES, including this superb RV-6, 6-inch available on easy terms!

Now it's easy to join the thousands of serious amateurs who have discovered the excitement of exploring our mysterious universe. Your enjoyment begins right from the start, yet the challenges and rewards go on for years! And it's a hobby that can be shared at modest cost.

Choose From Many DYNASCOPES®

Picking a telescope to fit your needs and your pocketbook is simple when you select a DYNASCOPE—the same instruments used by more than 150 schools, colleges and observatories—and your satisfaction is guaranteed by a full-refund warranty.

FASCINATING GUIDE YOURS FREE!



Read these valuable facts before buying any telescope. Mail coupon or postcard for your complimentary copy of this helpful guide.

Criterion Manufacturing Co.
620 Oakwood Ave., W Hartford, Conn. 06110

® TM Registered U.S. Pat. Office

CRITERION MANUFACTURING CO., Dept. NH-51
620 Oakwood Ave., W. Hartford, Conn. 06110
Please send your free Telescope Guide.

Name______________________________

Address____________________________

City________________State__________

The Rubáiyát of Omar Khayyám

This is a complete recording of Edward Fitzgerald's 5th version, and is the cumulative effort of three men of genius.

It is followed by a few comments and comparisons, and also Pedro Calderon de la Barca's The Dream Called Life and Life is a Dream.

Lastly, beginning with Hamlet's soliloguy, there is some of the best that is to be found in Shakespeare.

A purchaser writes: "The record is being played over and over, it is my treasure."

And from Canada, this judgment and request: "Because the record is such a beauty, send me another one . . ."

A superlative delivery of superlative poetry by Louis Zaul.

$8.00

Plus Applicable Sales Tax
(only for N.Y. State residents)
Available Only By Mail

PUBLIC OPINION
Box N-4044 Long Island City, Long Island
New York 11104

1. Soak brains in several changes of cold water for two hours. Peel off the outer membrane and discard. Soak for another two hours in cold water acidulated with 1 tablespoon of vinegar per quart. Drain brains and trim off solid white pieces at the base.
2. Bring to a boil in a nonaluminum saucepan enough water to cover the brains. Acidulate as above and add 1 teaspoon salt per quart of water. Plunge the brains into the water, reduce heat so as to produce a very slow simmer, and cook for 20 minutes. Drain.
3. At the same time, simmer the shrimp for 5 minutes in a separate, nonaluminum saucepan, in a broth consisting of water to cover, wine, and 1 teaspoon salt. Drain, peel, and devein shrimp.
4. Bring 1 quart of water and 1½ teaspoons salt to a rolling boil. Pour in the rice in a slow stream; stir once and boil, uncovered until almost tender, about 12 minutes. Drain well.
5. Preheat oven to 250°F.
6. Scald the milk. Add the blanched rice to it, let boil again, cover, and finish cooking in the oven for 30 minutes. Do not stir. Drain the rice and press out excess liquid.
7. Raise oven temperature to 350°F.
8. Butter the inside of a 5- or 6-cup, ovenproof mold.
9. Mix together the prepared brains, shrimp, and rice in a blender with eggs, 2 teaspoons salt, pepper, paprika, and heavy cream. Puree.
10. Pour the mixture into the mold. Set the mold in a pan of shallow, boiling water in the oven and cook for 35 to 40 minutes.
11. Remove mold from oven and let cool for 5 minutes. Unmold gently onto a serving dish; invert the serving dish over the top of the mold; then, holding mold and dish, rotate them as a unit, so that the mold ends up on top of the serving dish. The "bread" should simply slide out as the mold is raised.

Yield: Eight servings

Raymond Sokolov is a food columnist and editor of Great Recipes from The New York Times.

WIDE SHOES FOR MEN
EE to EEEEEE • Sizes 5-13

100 styles, top quality, popular prices, money-back guarantee. Send for FREE CATALOG.

Not sold in stores

Hitchcock SHOES, INC.
Dept. 72K, Hingham, Mass. 02043

PHOTOGRAPHERS!
ARE YOU LISTED in the *1975 Directory of Photographers?* List your name, address, phone and photo specialties to sell your work. Only $10. Directory available to Agencies, Publishers, Mail Order, AD's—anyone purchasing freelance photography. Mail listing and payment to:
Trafalgar House Publishing DK
460 E. 79th St., N.Y.C. 10021

NATURE ON STAMPS

The BIRDS & the BEES & the ANIMAL KINGDOM on GENUINE POSTAGE STAMPS.

* SAMPLES & APPROVALS – $1
Satisfaction Guaranteed

Mil Med Stamps
P.O. BOX 297-NH AURORA, CO. 80010

We invite you to see North America's greatest wildlife spectacular:

The Seals on the Icepack

Each year, in March, in Canada's Gulf of St. Lawrence, hundreds of thousands of seals end their southern migration and congregate on the moving icepack, turning the Gulf into a huge natural nursery as the females give birth to their babies.

In March 1975, by using a fleet of helicopters, three small groups of tourists will land on the ice and see this dramatic and incredibly beautiful spectacle.

Detailed brochure available from:
HANNS EBENSTEN TRAVEL, INC
55 WEST 42 STREET, NEW YORK, NY 10036
TELEPHONE (212) 354-6634

If you wish to attend a showing of Mr Brian Davies' 20-minute color film *Seal Song* and presentation of clothes suitable for the icepack, in New York City on December 5, 1974, please write to us and order your guest tickets

enjoy the treasures of mother earth!

the collector's cabinet
1000 Madison Ave., New York, N.Y. 10021
"the treasure house of natural history!"

Branches: Dania, Fla., Miami Beach, Fla., Syracuse, N.Y., Chadds Ford, Penna., Springfield Mall, Virginia. (Franchise information available)

Also at Bloomingdale's, N.Y. and 144 other fine dept. stores nationwide. Write for the store nearest you. Catalog "H" and 7 jumbo color postcards $1.00.

Enter the challenging world of nature with these exciting new books from Scribners

THE COMEDY OF SURVIVAL
STUDIES IN LITERARY ECOLOGY
JOSEPH W. MEEKER
THE COMEDY OF SURVIVAL
VICTOR B. SCHEFFER
A VOICE FOR WILDLIFE
A CALL FOR A NEW ETHIC IN CONSERVATION
SCHEFFER A VOICE FOR WILDLIFE
Life The Unfinished Experiment S. E. Luria
1974 NATIONAL BOOK AWARD WINNER
LOVE SONGS OF THE NEW KINGDOM
JOHN L. FOSTER
LIVING ANIMALS OF THE BIBLE
WALTER W. FERGUSON
LIVING ANIMALS OF THE BIBLE

1. THE COMEDY OF SURVIVAL
Studies in Literary Ecology
Joseph W. Meeker. Foreword by Konrad Lorenz. Original and witty exploration of the biological themes and relationships which appear in literary works. $8.95

2. A VOICE FOR WILDLIFE
Victor B. Scheffer. An appreciation of birds and beasts by the author of *The Year of the Whale* in which Dr. Scheffer calls for a new ethic in conservation. $8.95

3. THE SINGING LAND
Vincent Serventy. Twenty-two natural environments of Australia are described and depicted in 48 full-page color photos. 7½ x 10¼. $6.95

4. THE PACIFIC ISLANDERS
William Howells. A distinguished physical anthropolgist presents a perspective for understanding the people who now inhabit Oceania. $12.50

5. THE GREAT BARRIER REEF
Isobel Bennett. A profusely illustrated description by a marine biologist of the greatest natural wonder of the southern seas. 400 photos in color and black and white, maps, drawings. 10 x 12. $17.50

6. THE ABORIGINES OF SOUTH-EASTERN AUSTRALIA—AS THEY WERE
Aldo Massola. An anthropologist's study of the life and customs of a people whose culture no longer exists. Photos, maps. $12.50

7. AUSTRALIAN MARSUPIALS AND OTHER NATIVE ANIMALS
Michael Morcombe. Profusely illustrated guide to some 200 species of mammals. Over 100 full-color photos and drawings. 8½ x 11½. $7.95

8. BIRDS OF AUSTRALIA
Michael Morcombe. An outstanding nature photographer's action photos—over 75 in full-color—of Australian birds. 8¾ x 11¾. $7.95

9. THE BULL
Allan Fraser. A popular survey of the bull in history, mythology, religion, art, sport, and stockbreeding. Illustrated throughout, with 16 pages in color. $12.50

10. SIMPLE ASTRONOMY
Iain Nicolson. A lively account of the celestial bodies by a professional astronomer, profusely illustrated in two colors. $6.95

11. NICOLAUS COPERNICUS AND HIS EPOCH
Jan Adamczewski. The life, work, and times of the famous astronomer. Numerous photos in color and black and white. $7.95

12. LIFE—THE UNFINISHED EXPERIMENT
S. E. Luria. 1974 National Book Award winner. The basic facts of genetics and molecular biology, presented clearly by a world-famous scientist. $2.95 paper

13. LOVE SONGS OF THE NEW KINGDOM
John L. Foster. Lusty translation of surviving ancient Egyptian poems, beautifully illustrated with scenes of daily life from tombs at Thebes and hieroglyphic transcriptions of the original texts. $10.00

14. FISH-WATCHING AND PHOTOGRAPHY
Kendall McDonald. Practical techniques for studying fish in their natural habitat, with detailed advice on underwater photography and a catalog of fish by species and habitats. 64 pages of color and black and white photos. $10.00

15. ART ON THE ROCKS OF SOUTHERN AFRICA
D. N. Lee and H. C. Woodhouse. Foreword by Raymond A. Dart. Over 200 photos, many in full color, of the extraordinary rock paintings of prehistoric man hidden in the hills and valleys of Africa. $15.00

16. ILLUSION IN NATURE AND ART
R. L. Gregory and E. H. Gombrich, Editors. First full-scale treatment of the problems posed by illusion, including new theories and experiments. Over 200 illustrations, 22 in color. $19.95

17. THE WILD FLOWERS OF BRITAIN AND NORTHERN EUROPE
Richard Fitter and Alastair Fitter. Profusely illustrated guide to most of the native flowering plants of the northwestern quadrant of Europe. Color illustrations depict over 1,200 plants. $10.00

18. LIVING ANIMALS OF THE BIBLE
Walter W. Ferguson. Full-color paintings and concise text portray over a hundred animals known in Biblical days that still exist. 8¼ x 10¾. $9.95

19. SCIENCE CALENDAR 1975
National Science Teachers Association. Thirteen full-color photographs representing various aspects of science and technology, drawings by Anthony Ravielli commemorating famous people and events on specific dates, information on equinoxes, solstices, eclipses, and phases of the moon. 10⅛ x 13½. $3.95

20. MAN'S RESPONSIBILITY FOR NATURE
Ecological Problems and Western Tradition
John Passmore. A philosopher's penetrating rebuttal to the argument that the West needs a whole new ethic to deal with current ecological problems. $7.95

21. NATURE PHOTOGRAPHY: ITS ART AND TECHNIQUES
Heather Angel. Comprehensive book by a well-known biologist on how to photograph all the major groups of plants and animals. 24 pages of color photos, 150 black and white photos. $14.95

22. SEED EATING BIRDS AS PETS
Cyril Rogers. Concise account of the many and varied species of domesticated birds—keeping, feeding, breeding, etc. Over 50 photos in color and black and white, diagrams. $7.95

23. THE UNOFFICIAL COUNTRYSIDE
Richard Mabey. How to look for and enjoy the plants and creatures that flourish in cities despite man's interference. $7.95

At your bookstore or write to:
CHARLES SCRIBNER'S SONS, Dept. MN
597 Fifth Avenue, New York, N.Y. 10017

Please send me the books I have circled. Enclosed is a check or money order which includes 50¢ for postage and handling, plus appropriate sales tax.

1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12.
13. 14. 15. 16. 17. 18. 19. 20. 21. 22. 23.

Name________________ Address________________

City________________ State________ Zip________

When drizzle turns to drench.

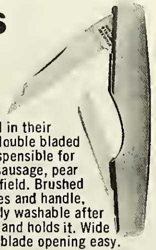
An attractive, weatherproof jacket of polyvinyl over comfortable cotton. From Sweden. Well reinforced and guaranteed waterproof, it has attached visored hood edged in corduroy. Hot Pink, Powder Blue, Grass, or Yellow. Sizes XS,S,M,ML, or L. $38. The Country Store of Concord, 15 Monument St., Concord, Mass. 01742. Include $1 postage.

The Country Store of Concord

Guilford, Greenwich, Ct. Far Hills, N.J.
Falmouth, Me. Concord, Westwood,
Beverly Farms, Edgartown, Nantucket, Mass.

England's classic cut-up

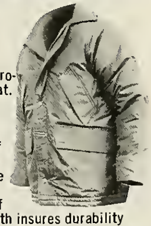
The British have been putting a Wilkinson Sword in their pockets since 1772. This double bladed delight will be found indispensible for gardening—or cutting a sausage, pear and cheddar lunch in the field. Brushed satin stainless steel blades and handle, make this knife completely washable after use. It takes a keen edge and holds it. Wide fingernail notches makes blade opening easy. Thin and light. Won't wear a hole in your pocket. 3½" long closed. 1½ oz. light.
008-Wilkinson all-purpose/garden knife $10.95 ppd.



Go down under

And feel warm all over. Introducing the MPC Petrel Coat. This superb insulated garment contains 100% Prime Northern European Goose Down. (Not a mix of feathers). The Petrel coat has unequalled wide-range temperature capabilities. The rugged outer fabric of 60-40 (Dacron- Cotton) cloth insures durability and prevents Down "leakage". Snap-over weather flap covers the heavy duty front zipper. Heavy duty nylon cuffs; concealed drawstring at waist. Two large cargo pockets, plus one inside chest pocket, two large slash pockets. Colors: Sand, Spruce Green. Sizes: Men's; S,M,L,XL. (Men's S and M will fit Women's Medium & Large). Wt. 2½ lbs.
007-MPC Petrel Coat $79.50 postpaid.
Satisfaction Guaranteed or your money back.
Check or Money Order (sales tax where applicable)

Outback™
1700 York Avenue, New York, N.Y. 10028



Additional Reading

CHEAP POWER FANTASY (Page 16)

Communities and Ecosystems. R. H. Whittaker. Macmillan, Inc., New York, 1970.

The Study of Plant Communities. H. J. Costing. W. H. Freeman and Company Publishers, San Francisco, 1956.

Fundamentals of Ecology. E. P. Odum. W. B. Saunders Company, Philadelphia, 1971.

BIOSPHERIC GAMBLERS (Page 36)

The Orchid World. Walter Richter. E. P. Dutton and Company, Inc., New York, 1965.

Beautiful Orchids. P. M. Black. Hamlyn Publishing Group (Canada), Ltd., Don Mills, 1973.

Evolutionary Significance of the Geographical Distribution of Orchids. L. A. Garay. Proceedings 4th World Orchid Conference, Singapore, 1964.

The Biology of the Orchids. C. H. Dodson and R. J. Gillespie. Mid-America Orchid Congress, 1967.

SONG OF THE BUNTING (Page 46)

Bird Vocalizations. R. A. Hinde. Cambridge University Press, New York, 1969.

Bird-song. W. H. Thorpe. Cambridge University Press, New York, 1961.

Mechanism of Animal Behavior. P. R. Marler and W. J. Hamilton. John Wiley and Sons, Inc., New York, 1966.

The Life of Birds. J. C. Welty. W. B. Saunders Company, Philadelphia 1962.

SHARECROPPER'S PLAGUE (Page 52)

The Butterfly Caste. E. W. Etheridge. Greenwood Publishing Corporation, Westport, 1972.

Goldberger on Pellagra. M. Terris, ed. Louisiana State University Press, Baton Rouge, 1964.

A Plague of Corn. D. A. Roe. Cornell University Press, Ithaca, 1973.

FRAGILE DINOSAURS (Page 64)

Men and Dinosaurs. E. H. Colbert. E. P. Dutton and Company, New York, 1968.

Before the Deluge. Herbert Wendt. Doubleday Publishing Company, New York, 1968.

Some Victorians and the Dinosaurs. E. H. Colbert. *Natural History*, April, 1962.

SHARANAHUA HUNT (Page 72)

Yanomamo. N. A. Chagnon. Holt, Rinehart and Winston, Inc., New York, 1968.

Headhunter's Heritage. R. F. Murphy. University of California Press, Berkeley, 1960.

The Cubeo. I. Goldman. University of Illinois Press, Urbana, 1963.

Discover Galapagos

For budget-minded travelers who are interested in ecology, wildlife and photography, we are repeating our extremely popular
GALAPAGOS ISLANDS THRIFT CRUISE
in the privately chartered 68-passenger mv Iguana*:

May 30 to June 13, 1975
accompanied by Mrs. Eileen K. Schofield Herbarium Specialist at the New York Botanical Gardens

July 11 to 25, 1975
accompanied by Mr. Belton P. Mouras President of the Animal Protection Institute of America

Before the cruise, we spend four days in Quito, Ecuador's lovely capital, with excursions in the Andes, and then make the spectacular railroad journey down to the coast.

Detailed brochures are available from:
HANNS EBENSTEN TRAVEL, INC
55 WEST 42 STREET, NEW YORK, NY 10036
TELEPHONE (212) 354 6634
* Registered in Ecuador

RADIO SHOWS OF THE GOLDEN AGE

Relive the Greats of the 30's & 40's. Relax and enjoy listening to comedy, mystery, drama and big bands. Or invite your friends for an evening of unforgettable nostalgia! For FREE literature and program listings of tapes, cassettes & LP Albums, write:
THE RADIO STORE - NI, Box 590, 57 Front St, Bklyn, NY 11201

out of print, scarce, rare NATURAL HISTORY BOOKS

The Book Chest

Botany, Zoology, Orchidology, Ornithology, Entomology, Ichthyology, Herpetology, etc.
CATALOGUE 7 AVAILABLE

19 Oxford Place/Rockville Centre, New York 11570

FIFTY JUNGLE BUTTERFLIES $2.95 · THIRTY EXOTIC SEASHELLS $1.95 · FIFTEEN BEETLES—WORLDWIDE $3.25 · EIGHTEEN GEM-STONES $2.25

PLUS giant Natural Hobbies Bargain List with many school projects and gift suggestions.
Dept.H, Collectors' Wonderland-Box 1170, N.Y. 10008

SURVIVAL IN THE WILDERNESS

Eastern and Western U.S. High Peaks, Canadian & Northeastern Waterways.
Fall, Winter, Spring: Weekend Trips, Holiday Outings, Concentrated Courses.
Summer: Two-week & Intensive Month-long Courses & Expeditions. Basic and Advanced Survival Instruction. On foot, skis, snowshoes, by canoe. Write for definitive brochure: H
North American Wilderness Survival School
205 Lorraine Ave. Upper Montclair, N.J. 07043
Tel: 201-783-7711

KOMURA / BROOKS 2 x TELE EXTENDER
MULTICOATED 4 ELEMENT
DOUBLE FOCAL LENGTH AT A FRACTION OF CAMERA LENS PRICE
FOR
HASSELBLAD
BRONICA
MAMIYA RB 67
PENTAX 6 x 7
BURLEIGH BROOKS OPTICS, INC. • 44 BURLEWS CT., HACKENSACK, N.J. • 201-489-1300

THE COLLECTED WORKS OF SIR WINSTON CHURCHILL

How do you begin to tell about one of the most significant publishing events of our time? Do you begin with the man who is being honored through his words? Sir Winston Churchill. Or do you begin by talking about this unique set of books itself? As an investment? As art? As a history of some of the most momentous events of the first half of this century? For *The Collected Works of Sir Winston Churchill*, published to mark his centenary, by The Library of Imperial History, London, England, is all these things.

If you were fortunate enough to be able to find even one rare out-of-print first edition of any of Sir Winston's writings the price you would pay could be several times over the price of any one volume in this collection. Yet the collection is not just a unique and important first edition. It is a rare work of art because it becomes at once a part of the priceless heritage of our civilization.

The facts listed below may give you a small idea as to the workmanship that has gone into the production of these books.

Number of volumes in set: 34.

Binding: Each volume is fully hand bound in natural calfskin vellum.

Endpapers: Green levanto marble pattern, reproduced on special heavy text paper.

Book paper: High bulk, Archive Long Life Text. Estimated minimum working life, 500 years.

Page total in set: Approximately 17,000.

Titling: 22 carat gold.

Page edging: 22 carat gold.

You might also be interested in knowing what the rest of the world is saying about the collection.

The Rt. Hon. Edward Heath, Prime Minister of Great Britain, 1970-74 refers to it as "this great venture."

Sir Anthony Eden (Lord Avon), Prime Minister of Great Britain, 1955-57 speaks of "this splendid edition."

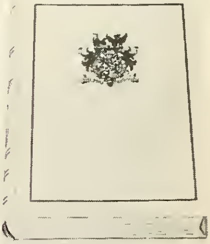
The Collected Works of Sir Winston Churchill is a first edition of such outstanding integrity, scholarship, craftsmanship, and beauty that it must be limited to universities and major libraries of the English-speaking world, and to a comparatively small number of private subscribers.

In all, only 1000 sets of this 34-volume collection will be available in the United States. Two hundred of these have already been subscribed. By international copyright law they cannot be reprinted in any form for 42 years. And by United States copyright law, the edition will remain protected for a significant period thereafter.

As you can see the centenary limited edition is a one-of-a-kind that the future world is unlikely to see again. And you are invited to own it.

For $2500 or a deposit of $500 with twenty-four succeeding monthly payments, you will begin to receive *The Collected Works of Sir Winston Churchill*. Individual volumes—the first is immediately available—will be delivered every three weeks until the edition is completed at the end of the centenary year in 1975.

We urge you to reply promptly. *The Collected Works* is a first edition of which there can never be a second.



If you are one of the rare individuals who understands the true value of an investment, we suggest you invest in a rare individual.

The Library of Imperial History NB—10/4
415 Lexington Avenue, New York, New York 10017

Gentlemen: I wish to take advantage of this rare opportunity. Enclosed please find my ☐ check ☐ money order for: ☐ $2500; ☐ $500 (with the balance of $2000 to be paid over the next 24 months). ☐ I would prefer receiving additional information before making my decision. Enclosed you will find $1.00 for your illustrated brochure.

Name______________________________

Address______________________________

City____________State________Zip________

Celestial Events

by Thomas D. Nicholson

Sun and Moon Now well past the autumnal equinox, the sun is moving south, relative to the earth beneath it, at a very rapid rate, causing the days to grow shorter and the nights longer in the rush toward the solstice in December. Twice during October the sun and moon are in opposite directions, which means that the moon is full. The full moon of October 1 was the harvest moon; that of October 30 is known as the hunter's moon. The moon is new at mid-month in October, but we won't see it until the early crescent becomes visible in the evening on the 17th or 18th. First-quarter moon comes on October 22. In early November, we will have a last-quarter moon on the 6th and a new moon on the 13th.

Stars and Planets It's always a surprise to look toward the east early of an October morning and see the winter stars there, while in the west, the bright stars of summer are still quite high. Altair, Deneb, and Vega, associated with summer evenings, still dominate the sky. But look into the east at dusk. There are Aldebaran and the Pleiades, already above the horizon. And not long after, Orion rises. On October 21, the shower of meteors radiating from Orion (the Orionids) reaches maximum. The shower is modest in production (up to twenty-five per hour), but its objects are often quite bright, and there will be no moonlight to interfere during the after-midnight hours that are best for viewing.

October and November are meager months for planet watchers. They will find only one, Jupiter, well up in the east in the evening sky; two, Jupiter and Saturn, visible about midnight (after Saturn rises); and only one, Saturn, in the morning sky (Jupiter sets before dawn). The other planets, Mercury, Venus, and Mars, are all too close to the sun to be visible, although Mercury goes through a favorable morning elongation in early November.

October 16: The moon occults (covers) Mercury over some southwestern states, but both will be too low, in a bright sky, to be seen.

October 21: Orionid meteors reach maximum.

October 24: Moon is at apogee (farthest from earth).

October 25: Mercury, at inferior conjunction, passes between the sun and the earth.

October 25-26: Jupiter is near the moon on both evenings.

October 30: The full moon is the hunter's moon.

October 31: Saturn begins its retrograde motion.

November 2: Mercury resumes direct (easterly) motion.

November 3: Jupiter resumes direct (easterly) motion.

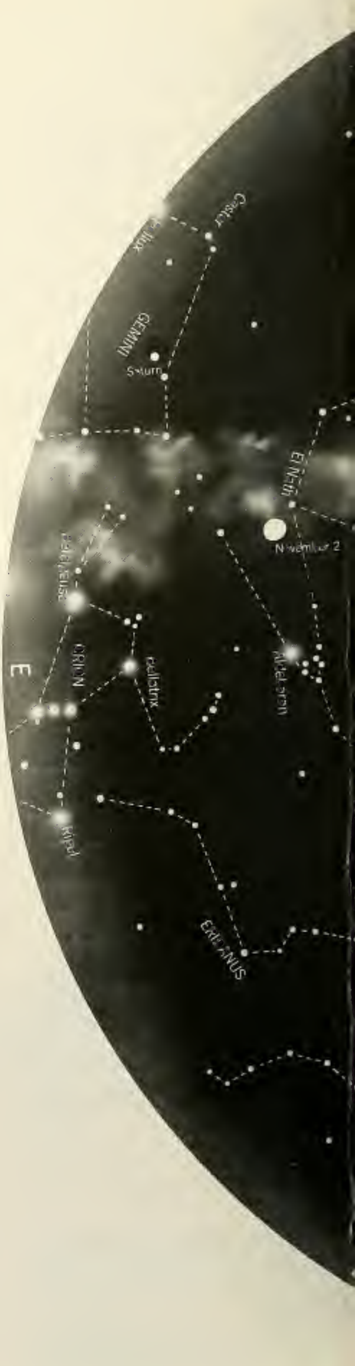
November 4: The weak Taurid meteors reach maximum, but there will be moonlight after midnight. Saturn is near the moon this evening.

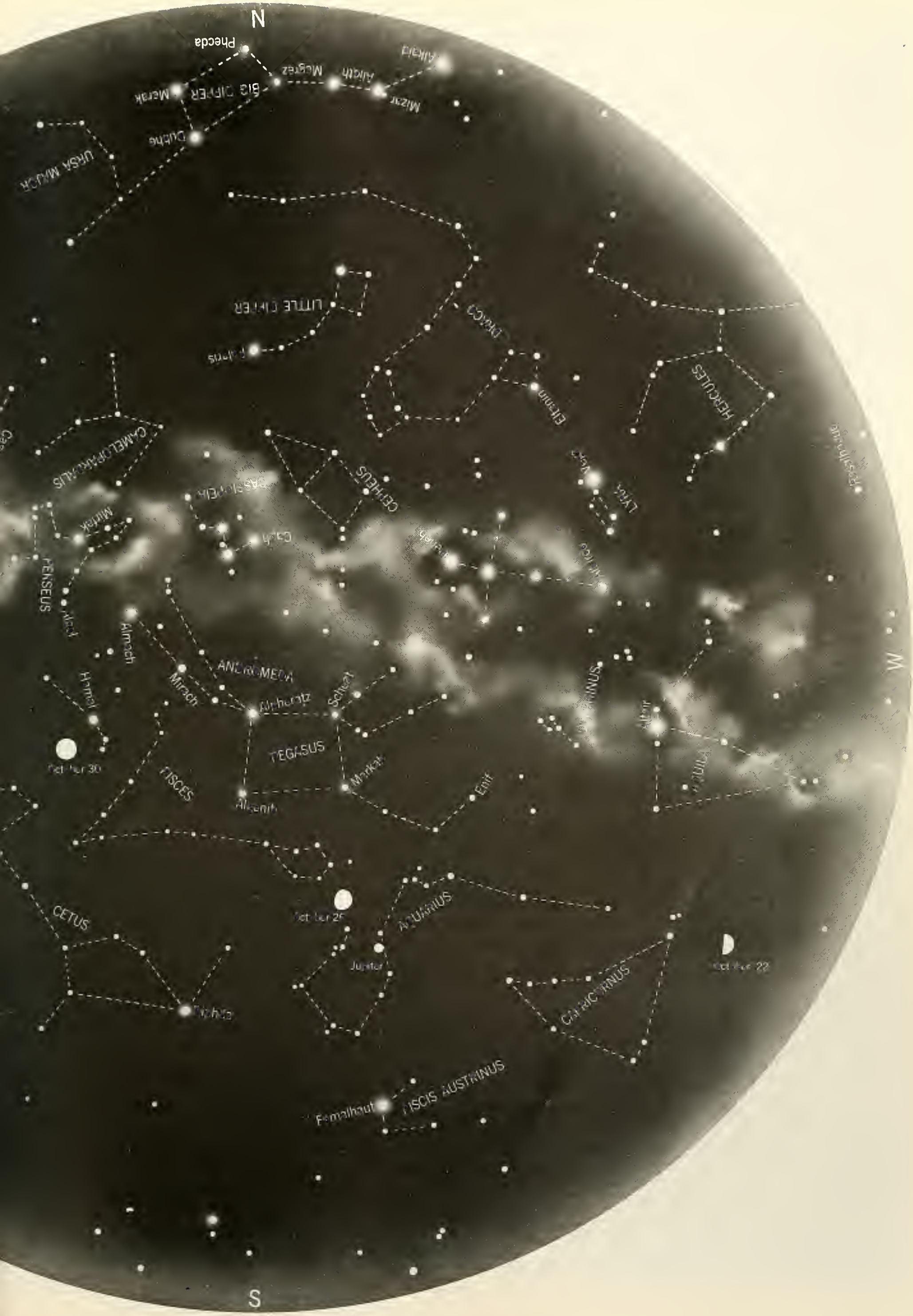
November 6: Venus is in superior conjunction (in line with, but beyond, the sun). It now enters the evening sky.

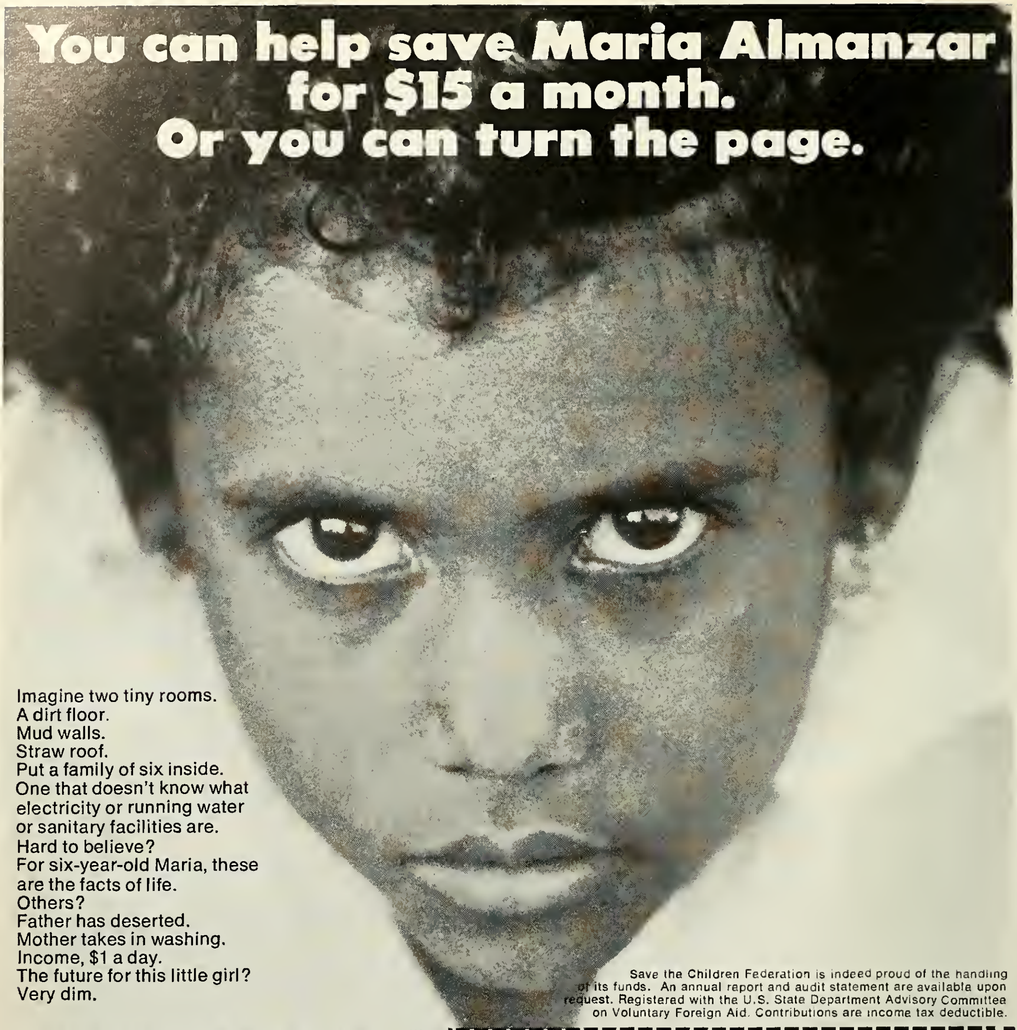
November 7: The moon is at perigee (nearest earth).

November 10: Mercury is at greatest elongation (distance from the sun) in the morning sky. It may be seen as a morning star, low in the east during morning twilight, for several days before and after the 10th. The star near Mercury is Spica, in Virgo.

★ Hold the Star Map so the compass direction you face is at the bottom, then match the stars in the lower half of the map with those in the sky near the horizon. The map is for 10:20 P.M. on October 15; 9:20 P.M. on October 31; and 8:20 P.M. on November 15; but it can be used for about an hour before and after these times.




N
Phecda
Megrez
Alioth
Alkaid
Mizar
BIG DIPPER
Merak
Dubhe
URSA MAJOR
LITTLE DIPPER
Polaris
DRACO
Eltanin
HERCULES
Rasalhague
CAMELOPARDALIS
CASSIOPEIA
CEPHEUS
Vega
LYRA
Mirfak
Caph
Deneb
CYGNUS
PERSEUS
Algol
Almach
ANDROMEDA
Mirach
Alpheratz
Scheat
Hamal
October 30
PEGASUS
PISCES
Markab
Enif
Algenib
DELPHINUS
Altair
AQUILA
W
CETUS
October 26
AQUARIUS
Jupiter
Diphda
CAPRICORNUS
October 22
Fomalhaut
PISCIS AUSTRINUS
S



You can help save Maria Almanzar for $15 a month. Or you can turn the page.

Imagine two tiny rooms.
A dirt floor.
Mud walls.
Straw roof.
Put a family of six inside.
One that doesn't know what electricity or running water or sanitary facilities are.
Hard to believe?
For six-year-old Maria, these are the facts of life.
Others?
Father has deserted.
Mother takes in washing.
Income, $1 a day.
The future for this little girl?
Very dim.

There's a better than even chance Maria will grow up illiterate. Because it costs money to go to school where she lives. Money that just isn't there. But for $15 a month you can sponsor a child like Maria in many countries around the world and here at home. Money for education. And clothing. And medical care. And a portion of your $15, combined with money from other sponsors, can help her whole community. With everything from a hot lunch program to a health center. In simple terms, to help them help themselves. This is what Save the Children has been about since 1932.

For you—educated, involved, and in touch with your own heart—there are many rewards. The chance to correspond with a child. Receive a photograph and progress reports. And above all know you are reaching out to another human being. That's how Save the Children works. But without you it can't work. So please: clip this coupon and mail it today. Now you can turn the page.

Save the Children Federation is indeed proud of the handling of its funds. An annual report and audit statement are available upon request. Registered with the U.S. State Department Advisory Committee on Voluntary Foreign Aid. Contributions are income tax deductible.

I wish to contribute $15 a month to sponsor a ☐ boy ☐ girl:

☐ **Where the need is most urgent**
☐ Appalachia (U.S.)
☐ Bangladesh
☐ Chicano (U.S.)
☐ Colombia
☐ Dominican Republic
☐ Greece
☐ Honduras
☐ Indian (U.S.)
☐ Inner Cities (U.S.)
☐ Israel
☐ Korea
☐ Lebanon
☐ Mexico
☐ Southern Black (U.S.)
☐ Tanzania
☐ Vietnam

Enclosed is my first payment:
☐ $180 annually
☐ $90 semi-annually
☐ $45 quarterly
☐ $15 monthly
☐ Instead, enclosed is my contribution of $________
☐ Please send me more information.

NAME__________ TEL. NO.________
ADDRESS__________
CITY______ STATE______ ZIP______

David L. Guyer, Executive Director

SAVE THE CHILDREN FEDERATION

345 East 46th Street, New York, N.Y. 10017

NH 10/4

Announcements

The American Museum of Natural History celebrates the fifth annual **West Side Day** on Saturday, October 5, from 10:00 A.M. to 4:45 P.M. There will be free admission for all and special presentations and performances throughout the day.

On West Side Day, visitors to the Museum in New York City are invited to stop in the Hall of Asiatic Mammals and enjoy a spectacular mosaic of the performing arts of India, including an original dance based on the tales from the Ramayana, sitar music, snake charming, and folk dancing.

Or you can stroll under the great blue whale in the Hall of Oceanic Life and hear the New York Camerata perform "Song of the Whale," a musical composition by George Crumb. You will also have a chance to talk to Museum scientists about life in the seas.

In the Hall of Mexico and Central America, you can make an "eye of God," listen to native folktales, or make a rubbing of an Aztec sun stone.

For detailed information on these and the many other events planned for the day call (212) 873-1300, extension 559 or 566.

Nearly one-half million **army ants** are the subject of the current exhibit in Roosevelt Memorial Hall. The 18- by 14-foot Plexiglas display case allows visitors to closely observe the fascinating social behavior of these insects. Dr. Howard R. Topoff of The American Museum, who is in charge of the exhibition, led the expedition in Panama, where the army ants were collected.

International House comes to the Museum on Sunday, October 20, with **"Joy in Every Land."** This program of song and dance around the world will be held at 2:00 P.M. in the auditorium and is free to Museum visitors.

The current **Sky Show** at the Hayden Planetarium in New York City, "Exploring the Milky Way," may be seen through November 25.

Sky Shows are at 2:00 and 3:30 P.M. during the week, with more frequent showings on weekends. Admission is $1.75 for adults, $1.00 for children. For more information, telephone (212) 873-8828.

Dr. Malcom Arth, Chairman of the Museum's Education Department, is presenting a six-part Tuesday evening lecture course entitled **Aging: The Process and the Prospects** beginning October 8, at 7:00 P.M. Dr. Arth is an anthropologist who has spent several years studying the role of the aged, both in our own society and in other cultures. In his lectures, he will examine the phenomenon of aging in social, political, and religious contexts and explore the question of what it really means to grow old.

At the second session, Dr. Margaret Mead will participate as guest lecturer; the topic is "Looking Inwards."

The third lecture will include the screening of an extraordinary eighty-minute documentary film about a grandmother in an American family.

The fee for the entire series is $25. For detailed information about this and the other fall courses planned by the Education Department, call (212) 873-7507.

Insects All Around Us, a six-session Weekend Laboratory Workshop, will begin on Saturday, October 19. The workshop, which is geared for fifth and sixth grade children, will cover insect identification as well as mounting and preserving specimens. The fee for the course is $20. Write to the Department of Education or call (212) 873-7505 for registration information.

Brain Puzzler's Delight

By E. R. Emmet

A treasury of unique mind-stretching puzzles that can be solved by straight, logical thinking and reasoning. No specialized math. Offers the pleasures of discovering solutions through use of ingenuity, imagination, insight, and logic. Stimulates and refreshes the mind. Fascinating, entertaining puzzles, arranged in order of difficulty, with (some amazing!) solutions and full explanations at end of book. ILLUSTRATED

Order Now!

$5.95, plus 50¢ handling, 10-Day Money Back Guarantee

Handbook of Knots & Splices

By CHARLES E. GIBSON

Now tie knots for *every* purpose — useful, ornamental, fun-to-make!

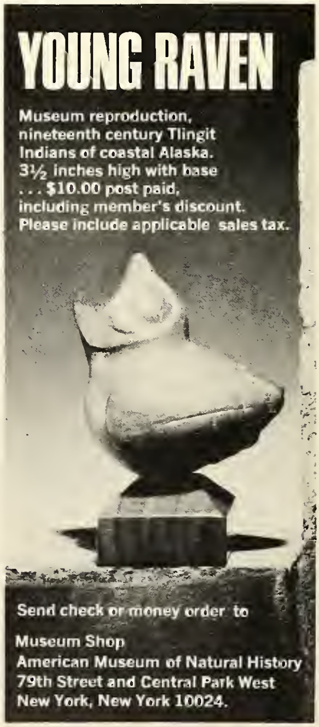
Book gives complete "1-2-3" sketches and instructions for every hitch, splice, bend, sling, lashing or whipping you'll ever need for boating, camping, climbing, fishing, hunting . . . for patio awnings, swings, hammocks, rope fences, "welcome" mats . . . ornamental lamps, vases, bell ropes, key chains, buggy whips, cat-o-nine tails, rope handcuffs, play quoits, etc.

They're all here . . . over 100 kinds of knots and rope-work! From the simple square knot to such fancy numbers as the Manrope, Stopper, Shroud, Crown, Turk's Head, and Pineapple knots. Also covers plaiting, brading, much more! "Highly recommended."—*Library Journal.*

Profusely illustrated *ORDER NOW!*

$5.95, plus 50¢ handling. 10-Day Money Back Guar.

EMERSON BOOKS, Inc., Dept. 761a
Buchanan, New York 10511



YOUNG RAVEN

Museum reproduction,
nineteenth century Tlingit
Indians of coastal Alaska.
3½ inches high with base
. . . $10.00 post paid,
including member's discount.
Please include applicable sales tax.

Send check or money order to

Museum Shop
American Museum of Natural History
79th Street and Central Park West
New York, New York 10024.

LIVE IN THE WORLD OF TOMORROW . . . TODAY!

And our FREE 164 PAGE CATALOG is packed with exciting and unusual values in ecological and physical science items — plus 4,500 finds for fun, study or profit . . . for every member of the family.

A BETTER LIFE STARTS HERE

ACTUAL WORKING SOLAR HOME PLANS

Learn all about the most fascinating possible home of the future. It can be your "now" answer to today's energy crisis in housing. Expert Dr. Harry E. Thomason tells advantages, problems, savings, and more in this important 20-pg fact-filled booklet. Also includes 8-page oversize insert of basic, actual solar home plans, a valuable guideline to you and your architect in fitting space requirements, design ideas, and local area building codes.

No. 9440E....(Solar House Plans)....................$10.00 Ppd.

● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ●

PRO ELECTRONIC SOUND CATCHER

Parabolic mike w/18¾" reflecting shield & 2 I.C.'s in amplifier magnifies signals 100X that of omni-directional mikes. Catch a songbird ½ mile off; QB's huddle strategy; sounds never before heard. Super directivity gives highest signal to noise ratio poss. Safe: auto. cuts off ear damaging noises. Earphones, tape recorder output, tripod socket. Req. two 9v trans. batt. (not incl).

No. 1649E....(5½LB.)....................$299.00 Ppd.
BIG EAR "TOY" MODEL #80,176E....................$32.25 Ppd.

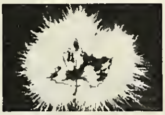
● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ●

MYSTERY OF ENERGY AND AGING

Science fact or farce? Can our Great Pyramid unlock the mysteries of energy & aging — show that the ancient Egyptians contradicted nature? Did someone really get 85 shaves from a blade kept in a pyramid? Test claims like meat not rotting, things not rusting! Users of exact scale models of Cheop's pyramid oriented to true North claim all sorts of strange phenomena based on resonating energy. Ours is already assembled, ⅛" see-thru acrylic, 6 x 9¼ x 9¼".

Stock No. 71,817E....................$20.00 Ppd.

● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ●



NEW! KIRLIAN PHOTOGRAPHY KIT!

Experiment in the fascinating new field of "Kirlian electrophotography—images obtained on film without camera or lens by direct recording of electric charge transmitted by animate & inanimate objects." Each "aura" differs—animate aura said to change corresponding to physical changes. Kit incls portable darkroom, double transformer isolated from power source; instrs.

Stock No. 71,938E....................$49.95 Ppd.
"HIGH VOLTAGE PHOTOGRAPHY" by H. S. Dakin
No. 9129E....(60-PG. PPBK BK.)....................$5.00 Ppd.

GREAT INT'L. PAPER PLANE BOOK!

Official fly-them-yourself book of paper airplanes from *SCIENTIFIC AMERICAN'S* "1st International Competition". Includes plans of all winning entries, time-aloft records, photos, technical data, commentaries. Has 20 unusual designs on perforated pages for easy tear-out. You won't believe how some of them fly! Amusing, entertaining 128 pages, 9"x11¾".

Stock No. 9391E....................$2.95 Ppd.

● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ●

KNOW YOUR ALPHA FROM THETA!

For greater relaxation, concentration, listen to your Alpha-Theta brainwaves. Ultra-sensitive electrode headband slips on/off in seconds—eliminates need for messy creams, etc. Atch'd to amplifier, filters brainwaves, signals beep for ea. Alpha or Theta wave passed. Monitoring button simulates Alpha sound; audio & visual (L.E.D.) feedback. Reliable, easy-to-use unit comparable to costlier models. Completely safe. Comprehensive instruction booklet.

No. 1635E....(8x3x4"; 24 oz.)....................$128.00 Ppd.
LOW COST "Starter" UNIT,
No. 71,809E....................$49.95 Ppd.

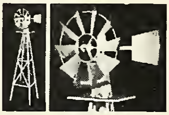
● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ●

ERECT A "PRO" WEATHER STATION

Match your forecasting skill with *anyone!* Set up permanent meterology sta. for reliable readings: windspeed, precipitation, barometric pressure, temp., humidity; get wind-chill, cloud types. Top qual. equipt.: rooftop remote reading pneumatic windspeed ind.; 11" rain guage; holosteric barometer (inches, etc.); hi-lo self register thermometer; wet-dry bulb hygrometer. More!

No. 80,216E....(w/372 PG. LOG)....................$59.95 Ppd.
BEGINNER'S KIT: COMPL., LOW COST
Stock No. 71,022E....................$18.95 Ppd.

● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ●



AUTHENTIC SCALED WINDMILLS

Real-thing replicas show wind direction, wheel silently revolves on ball bearings. Give your grounds unique rural charm! Great centerpiece for planter, flowers. Use to hold yard light, house number, sign or as mailbox. For school, a fine "energy crisis" science project — does everything but pump water. Heavy gauge steel, durable outdoor finish; aluminum color w/red trim.

No. 71,823E....(17" DESK MODEL)....................$10.95 Ppd.
4½ FOOT—14 LB.....No. 71,924E....................$32.50 Ppd.
8 FOOT—46 LB.....No. 85,229E....................$44.95 FOB

● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ●

3" ASTRONOMICAL REFLECTING TELESCOPE

See stars, moon, planets close-up! 30 to 90X. Famous Mt. Palomar Type. Aluminized & overcoated 3" diameter f/10 primary mirror, ventilated cell. Fork type equatorial mount. Durable PVC tube. Includes 1" F.L. 30X Ramsden, Barlow lens to triple power, 3X finder telescopes, hardwood tripod. FREE: "STAR CHART", "HOW TO USE" book.

Stock No. 85,240E....................$ 49.95 Ppd.
DELUXE 3" REFLECTOR TELESCOPE....#80,162E....................$ 79.95 Ppd.
4¼" REFLECTOR (45X to 135X)....#85,105E....................$148.50 FOB
6" REFLECTOR (48X to 360X)....#85,187E....................$249.50 FOB

MAIL COUPON FOR GIANT FREE CATALOG!

164 PAGES • MORE THAN
4500 UNUSUAL BARGAINS

Completely new Catalog. Packed with huge selection of telescopes, microscopes, binoculars, magnets, magnifiers, prisms, photo components, ecology and Unique Lighting items, parts, kits, accessories — many hard-to-get surplus bargains 100's of charts, illustrations For hobbyists, experimenters, schools, industry.

EDMUND SCIENTIFIC CO.
300 Edscorp Building, Barrington, N. J. 08007

Please rush Free Giant Catalog "E"

Name____________________

Address____________________

City__________ State________ Zip________

COMPLETE & MAIL WITH CHECK OR M.O.

☐ PLEASE SEND GIANT FREE CATALOG "E"

30 DAY MONEY-BACK GUARANTEE
YOU MUST BE SATISFIED OR RETURN ANY PURCHASE IN 30 DAYS FOR FULL REFUND

EDMUND SCIENTIFIC CO. 300 Edscorp Building, Barrington, N.J. 08007

How Many	Stock No.	Description	Price Each	Total

Add Handling Chg.: $1.00, Orders Under $5.00, 50¢, Orders Over $5.00

TOTAL $________

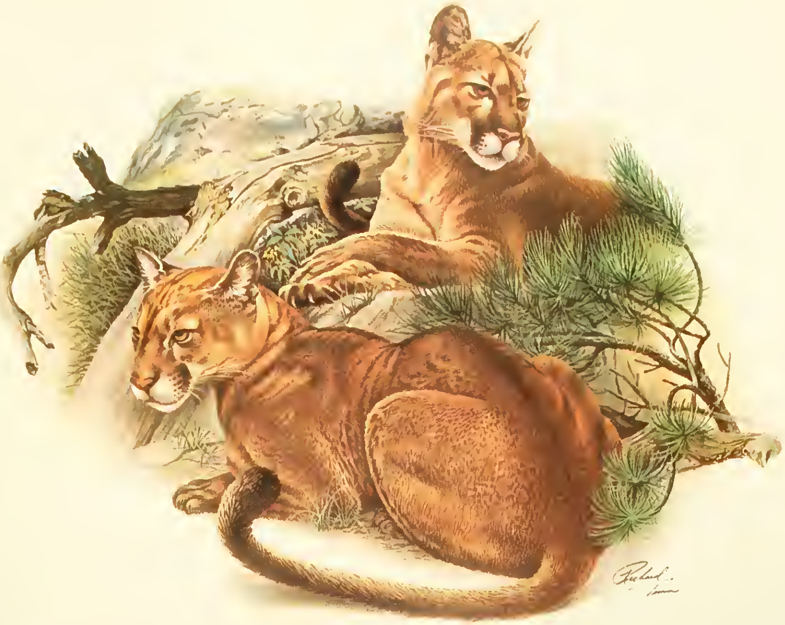
I enclose ☐ check ☐ money order for $________

NAME ____________________

ADDRESS ____________________

CITY__________ STATE________ ZIP________

When a picture is this beautiful it doesn't need to be a good investment.



Today's prevailing price, $50.

Plate 12

(Prices subject to change without notice.)

But this one is.

"Mountain Lion" by Richard Timm

1. For many years Nature House has been producing the finest quality Nature art available.
2. Each limited edition collector print is 22x28 inches, signed and serial numbered, edition limited to 5,000.
3. Set appreciation to date over 200% of its original value in two years.
4. The knowledgeable collector, recognizing the likelihood of early appreciation, will also realize the advantage of early purchase.
5. History is being made since Timm is the only artist to do exclusively North American Mammals.
6. Other subjects in the Timm collection include "Red Fox," "Raccoon," "Elk," "Striped Skunk," "Eastern Chipmunk," "River Otter," "White-tailed Deer," "Bobcat," "Eastern Cottontail," "Badger" and "Beaver".

Write for a free color brochure with the latest releases of the Richard Timm Mammals and the name of the dealer in your area.

Nature House, Box 398, Griggsville, Illinois 62340

America's finest nature collector prints

Richard Timm - only artist to do exclusively North American mammals. Maryrose Wampler - winner of the 1974 national flower contest. Richard Sloan - considered greatest wild bird artist of the 20th Century.

IF YOU'RE GOING TO SPEND THE MONEY FOR AN ELECTRONIC SHUTTER CAMERA, MAKE SURE IT HAS A SYSTEM.

XK
minolta
minolta
minolta
minolta
minolta

There are several electronically controlled 35mm reflex cameras on the market these days.

But only one combines the advantages of electronics with the versatility of a total system.

While other electronic cameras may allow you to switch lenses, the Minolta XK goes far beyond that with a system of 4 interchangeable finders and 9 interchangeable viewing screens.

This, together with a choice of interchangeable Rokkor-X lenses from 16mm fisheye to 1600mm super-telephoto, provides versatility unavailable on any other electronic camera in he world.

The heart of the Minolta XK is, of course, an electronically controlled titanium shutter. Its range of speeds is wider than on any camera in the world: from 16 full seconds to 1/2000th second, including X-synch at 1/100th. And shutter accuracy is so critical that you can check your watch by it.

When equipped with the Auto-Electro Finder, the Minolta XK will automatically set the precise shutter speed from 4 to 1/2000th second for any pre-selected f/stop. If light conditions call for 1/89th of a second or 1/1827th, that's what you get. Not the nearest compromise. For bracketing or special situations, you can override automatic operation as much as two stops up or down. Or ignore it completely and set exposure manually.

Unlimited exposure control is but one aspect of the creative freedom and handling ease you will experience with the Minolta XK. Even as you hold the camera, an automatic switch activates the metering system. And the Auto-Electro Finder provides all the information you will need for automatic, match-needle or manual operation, including shutter speed and aperture settings and a pulsating signal to warn of insufficient light.

For all its versatility, the Minolta XK is remarkably lightweight and easy to use. If you're at all serious about photography, this is a camera, and a system, worth examining personally.

For literature, test report reprints and the name of your nearest retailer, write to Minolta Corporation, Advanced Systems Division, 101 Williams Drive, Ramsey, New Jersey 07446. In Canada: Anglophoto Ltd., P.Q.

THE MINOLTA XK SYSTEM

Now, you can take electronic cameras seriously.

NATURAL HISTORY

NOVEMBER 1974 • [illegible]

The Chryslers for 1975.

1975 Chrysler Imperial

1975 Chrysler Cordoba

Excellence in three sizes.

1975 Chrysler New Yorker

Imperial

Imperial LeBaron. The proudest Chrysler. An automobile dedicated to elegance, convenience, comfort and luxury.

There's a strong possibility that LeBaron may be the most comfortable automobile you've ever experienced.

Individually adjustable seats come in warm crushed velour. Available is a version in specially pre-softened leather.

Look into America's other two luxury cars. The 1975 LeBaron is most confident of comparison.

New Yorker

New Yorker Brougham. A Chrysler that continues to set its own distinctive standards in design, luxury, and innovative engineering.

Yesterday it was Electronic Ignition. Today, a new spark plug that can last up to 50,000 miles on unleaded gas.

New Yorker's conveniences leave little to be desired. Its luxury interiors leave even less.

New Yorker Brougham. Still a most beautiful balance between desirability and affordability.

Cordoba. The new small Chrysler.

Designed faithfully in the rich traditions of Chrysler convenience and luxury, Cordoba is at once an automobile of great beauty and harmony.

Seats are available in velour or fine Corinthian leather.

We invite you to experience this new automobile soon at your Chrysler-Plymouth Dealer's. So very luxurious—and yet surprisingly affordable—Cordoba is proudly a Chrysler.

Cordoba. The new *small* Chrysler.

The Chryslers. Imperial. Chrysler. Cordoba.

CHRYSLER
MOTORS CORPORATION

Now's the time to invest in signed originals by Waterford.®

There's no more propitious time for you to invest in Waterford.

Each piece is a signed work of art, made by hand with heart, as it was two hundred years ago.

Even then, it inspired little odes on the part of people who wrote advertisements for Waterford.

Like this one, which appeared in 1790.

The shop is now
completely stored
with choicest glass from
Waterford—
Decanters, Rummers, Drams
and Masons.
Flutes, Hob Nobs, Crofts
and Finger Basons,
Proof Bottles, Goblets, Cans
and Wines,
Punch Juggs, Liqueurs and
Gardevins,
Salts, Mustards, Salads,
Butter Keelers,
And all that's sold by other
dealers.

The spelling has changed somewhat, but not the Waterford. Each piece is still an investment in timeless beauty. You live with it now, yet it grows more valuable with the passing years.

Look for the signature before you buy crystal. Hold Waterford to the light and you can see faintly etched the mark that identifies it as an authentic work of art.

Visit the Waterford Gallery at the important store in your area. Or write for free full-color booklet.
Waterford, 225 Fifth
Avenue, New York
10010.

Isn't it time you started collecting signed originals by Waterford?

(And English bone china by Aynsley, to go with it.)

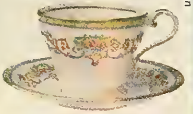


photo: Pesin

NATURAL HISTORY

Incorporating Nature Magazine
Vol. LXXXIII, No. 9
November 1974

The American Museum of Natural History
Gardner D. Stout, President
Thomas D. Nicholson, Director

5 Authors

14 The Changing Prey of Maine's Early Hunters
Dean Snow
Ocean fishing is a 5,000-year-old American pastime.

26 Letters

33 This View of Life: An Unsung Single-celled Hero
Stephen Jay Gould
Why did such diversity of life burst forth in the early Cambrian?

44 The Graceful and Rapacious Weasel
E. Raymond Hall
A single animal consumes 1,300 mice annually.

52 Stripping the Appalachians
Branley Allan Branson
Stealthily, the life-smothering silt seeps down the disturbed mountains.

62 Island of Saints, Scholars, and Scléip
John C. Messenger
On rare "great nights" the Irish islanders reach the heights of jollification.

70 Ecology of the Intestinal Tract
Gerald T. Keusch
Your digestive system has a life of its own.

80 Desert Adaptation
Photographs by Anthony Bannister
A snake's bag of survival tricks.

82 A Matter of Taste: Realm of the Rice Eater
Raymond Sokolov

86 Sky Reporter: Détente in Space
Michael B. McElroy
Astronauts may have to learn Chinese, too.

94 Bios: Molding New Plants
Arthur W. Galston
New cellular research may lead to higher yields and better proteins.

98 The Great Irish Telescope
Trevor C. Weekes
Even by today's standards, this misplaced "Leviathan" was an amazing instrument.

103 Epitaph for a Fossil Hunter
A review by Ronald Singer
The indefatigable L. S. B. Leakey must forever be honored for his discoveries.

112 Celestial Events
Thomas D. Nicholson

115 Announcements

118 Additional Reading

Cover: *A long-tailed weasel, in its white winter coat, pauses during a hunt in an Alberta park. Photograph by Ed Cesar. Story on page 44.*

Alan Ternes, Editor
Thomas Page, Designer
Board of Editors:
Sally Lindsay, Frederick Hartmann,
Christopher Hallowell, Toni Gerber
Carol Breslin, Book Reviews Editor
Florence G. Edelstein, Copy Chief
Karen Bierstedt, Copy Editor
Angela Soccodato, Art Asst.
Diane Pierson, Editorial Asst.
Lillian Gindea
Rosamond Dana, Publications Editor
Editorial Advisers:
Dean Amadon, Dorothy E. Bliss,
Mark Chartrand, Niles Eldredge,
Vincent Manson, Margaret Mead,
Thomas D. Nicholson, Gerard Piel,
Richard G. Van Gelder

David D. Ryus, Publisher
L. Thomas Kelly, Business Manager
Sue Severn, Production Manager
Ernestine Weindorf, Administrative Asst.

Yung-mei Tong

Ann Brown, Circulation Manager
Joyce E. Klutch, Asst.
Joan Mahoney
Harriet Walsh

Harvey Oshinsky, Advertising Manager
Salesmen: Gordon Finley
Harry R. Jeter, Vic Asselin
Eileen O'Keefe, Production
Katrin Magnusson, Asst.

Publication Office: The American Museum of Natural History, Central Park West at 79th Street, New York, N.Y. 10024. Published monthly, October through May; bimonthly June to September. Subscriptions: $8.00 a year. In Canada and all other countries: $10.00 a year. Second-class postage paid at New York, N.Y. and at additional offices. *Copyright © 1974 by The American Museum of Natural History. No part of this periodical may be reproduced without the written consent of* Natural History. *The opinions expressed by authors do not necessarily reflect the policy of The American Museum.* Natural History *incorporating* Nature Magazine *is indexed in* Reader's Guide to Periodical Literature.

Change of address notices, undeliverable copies, orders for subscriptions, and other mail items are to be sent to
Natural History Magazine,
Membership Services, Box 6000,
Des Moines, Iowa 50306.

IF YOU'RE GOING TO SPEND THE MONEY FOR AN ELECTRONIC SHUTTER CAMERA, MAKE SURE IT HAS A SYSTEM.

XK
minolta
minolta
minolta
minolta
minolta

There are several electronically controlled 35mm reflex cameras on the market these days.

But only one combines the advantages of electronics with the versatility of a total system.

While other electronic cameras may allow you to switch lenses, the Minolta XK goes far beyond that with a system of 4 interchangeable finders and 9 interchangeable viewing screens.

This, together with a choice of interchangeable Rokkor-X lenses from 16mm fisheye to 1600mm super-telephoto, provides versatility unavailable on any other electronic camera in the world.

The heart of the Minolta XK is, of course, an electronically controlled titanium shutter. Its range of speeds is wider than on any camera in the world. from 16 full seconds to 1/2000th second, including X-synch at 1/100th. And shutter accuracy is so critical that you can check your watch by it.

When equipped with the Auto-Electro Finder, the Minolta XK will automatically set the precise shutter speed from 4 to 1/2000th second for any pre-selected f/stop. If light conditions call for 1/89th of a second or 1/1827th, that's what you get. Not the nearest compromise. For bracketing or special situations, you can override automatic operation as much as two stops up or down. Or ignore it completely and set exposure manually.

Unlimited exposure control is but one aspect of the creative freedom and handling ease you will experience with the Minolta XK. Even as you hold the camera, an automatic switch activates the metering system. And the Auto-Electro Finder provides all the information you will need for automatic, match-needle or manual operation, including shutter speed and aperture settings and a pulsating signal to warn of insufficient light.

For all its versatility, the Minolta XK is remarkably lightweight and easy to use. If you're at all serious about photography, this is a camera, and a system, worth examining personally.

For literature, test report reprints and the name of your nearest retailer, write to Minolta Corporation, Advanced Systems Division, 101 Williams Drive, Ramsey, New Jersey 07446. In Canada: Anglophoto Ltd., P.Q.

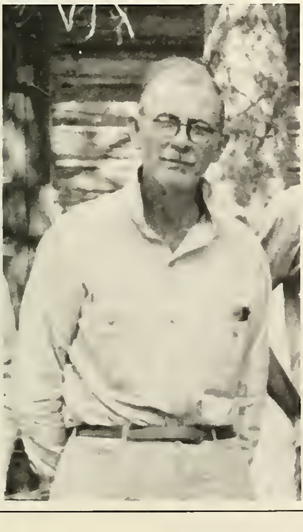
THE MINOLTA XK SYSTEM

Now, you can take electronic cameras seriously.

Authors

Dean Snow wrote his first essay on Indians when he was an eight-year-old schoolboy in the town of Sleepy Eye, Minnesota, and he has been fascinated by the subject ever since. He is now associate professor and chairman of the Department of Anthropology at the State University of New York at Albany. Dividing his time between anthropology and archeology, Snow has done field work in Mexico, in the Lake George area, and on the Saratoga battlefield in northeastern New York, where he located the British and American fortification lines. In addition to teaching and doing field work, Snow is writing a book on the archeology of North America. Designed for the general reader, the book is scheduled for publication in 1975.

Six years ago Branley Allan Branson undertook a project for the U.S. Forest Service to determine the effect of strip mining on fish in streams close to stripped areas. His study indicated that the increased amount of silt and chemicals released into such streams could, in some instances, virtually eliminate all life in and around the water. A biology professor for ten years at Eastern Kentucky University in Richmond, Branson is now studying the rare and endangered stream fish species of sections of Kentucky. He is also researching the distribution of mollusks throughout North America and hopes to make a similar investigation of land snails.



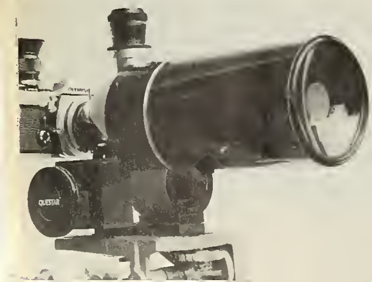
Since 1927, when he was working toward his doctorate in zoology at the University of California at Berkeley, E. Raymond Hall has published more than eighteen articles, as well as a book, on weasels. He has also written many articles and four additional books on a variety of other North American mammals, among them bats, mice, deer, gophers, and coyotes. Hall has been a biologist for the U.S. Department of Agriculture, the state zoologist of Kansas, vice-president of the American Association for the Advancement of Science, and a zoology professor at the University of Kansas in Lawrence. He is currently an ecological analyst at the university's museum of natural history, where his efforts are directed toward preserving natural ecosystems.

QUESTAR PHOTOGRAPHS THE NEIGHBORS

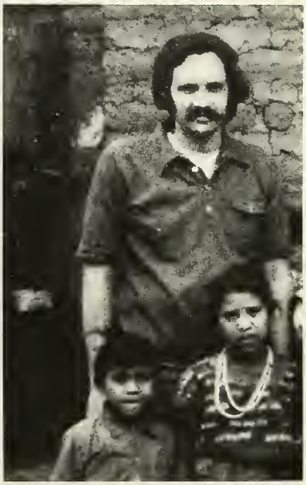
Fast shots with photo-visual Questar, like this watchful squirrel and rumpled flicker nestling, are easier than ever when you add our Fast Focus to the Field Model. And using this combination with the Questar-modified Olympus OM-1 camera body is a new and exciting experience for the nature photographer.

SEND $1 FOR THE QUESTAR BOOKLET WITH ITS 150 PHOTOGRAPHS BY QUESTAR OWNERS. $1 FOR MAILING ON THIS CONTINENT; BY AIR TO S. AMERICA, $2.50; EUROPE AND N. AFRICA, $3; OTHER AREAS, $3.50.

QUESTAR
BOX N 60, NEW HOPE, PA. 18938
©Copyright Questar Corporation 1974

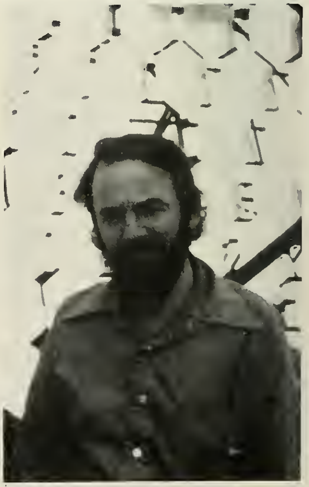


His first visit to Ireland, as a tourist in 1955, caused anthropologist John C. Messenger to switch his field of interest from Nigerian tribes to Irish peasants. With his wife, Betty, he has returned to Ireland many times to study three mainland and four island communities. His desire to record a traditional way of life before it disappeared under the impact of emigration and acculturation led him to do his research on a small island (which he calls by the pseudonymous name "Inis Beag") located off Ireland's west coast. Messenger is professor of anthropology at Ohio State University.



Gerald T. Keusch is an associate professor of medicine at Mount Sinai School of Medicine in New York City and is associated with that hospital's Division of Infectious Diseases. While doing field work on acute and chronic diarrhea in Thailand and Guatemala, he became aware of the enormous impact of intestinal bacteria on malnourished children. In addition to his experiences in the field, Keusch has conducted basic laboratory research on the interaction of malnutrition and infection, particularly the effects of protein-calorie deficiencies on leukocyte functioning. His interest in this field stems from his belief that through efforts to understand the microecology of the intestinal tract, ultimate control of disease will come.

Dublin-born Trevor C. Weekes is an astrophysicist. He received a Ph.D. in 1966 from the National University of Ireland in Dublin and shortly thereafter moved to the United States at the invitation of the Smithsonian Institution. He is currently the resident director of the Institution's Mount Hopkins Observatory in Arizona and a visiting professor of physics and astronomy at the University of Arizona in Tucson. Author of the book *High-Energy Astrophysics*, Weekes's main concern is gamma ray astronomy. His article in this issue of *Natural History*, written in one of his less scholarly moods, marks his debut in these pages.



Only one cassette deck stacks up with the best components.

Pioneer's new CT-7171 cassette deck with built-in Dolby, is undoubtedly the most extraordinary instrument of its type. Its sound reproduction is so exceptional that it not only eclipses the performance of other cassette decks, but it rivals the finest open-reel units.

To complement this remarkable performance, Pioneer has designed the CT-7171 with an important difference. All controls are up front so you can stack other components directly on top of it and beneath it. Even the illuminated cassette compartment is front loading, for easy access and visibility.

Performance features stack up, too. The CT-7171's illuminated VU meters, combined with a peak level indicator, refuse to let you over-record. A light emitting diode glows instantly when the signal peak level is too high. Then, to prevent "clipping" distortion, a studio-type switchable Level Limiter handles those unpredictable program source peaks.

No matter what type of tape you use — standard, low noise or chromium dioxide — the CT-7171 delivers optimum recording and playback with an assist from bias and equalization switches. With the new Ferrichrome tape, this unit performs beyond the limits of credibility.

Precision cueing has never been easier than it is with the CT-7171. You can actually pinpoint a recorded passage on a cassette with the combination of a memory rewind switch, the 3-digit tape counter and an exclusive Skip button that lets you monitor audibly at accelerated speed.

The CT-7171 also highlights an electronically controlled DC servo motor, two solid ferrite heads, automatic tape-end stop, dual concentric level controls, separate mic/line inputs, pause control, plus many other features to make it the most sophisticated cassette deck yet produced.

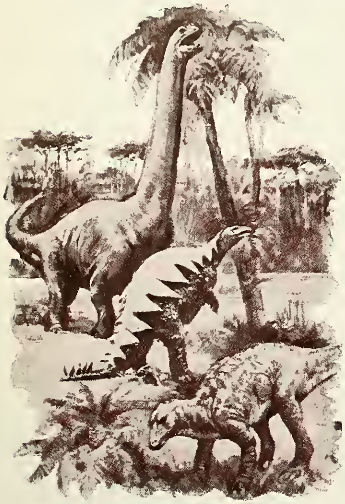
Because of its convenience, price and performance, the CT-7171 virtually obsoletes the 7-inch open-reel deck. And at $369.95, it's an unexcelled value for studio-quality reliability, design and versatility.

U.S. Pioneer Electronics Corp., 75 Oxford Drive, Moonachie, New Jersey 07074
West: 13300 S. Estrella, Los Angeles 90248 / Midwest: 1500 Greenleaf, Elk Grove Village, Ill. 60007 / Canada: S. H. Parker Co.

PIONEER
when you want something better

PIONEER STEREO TUNER MODEL TX-9100
MEMORY
OFF
ON
LIGHT
OFF
PEAK
REC
SKIP
REW
PLAY
F.F
PAUSE
EJECT
DOOR
POWER
OFF
ON
DOLBY NR
TAPE
BIAS
EQ
REC LIMITER
OFF ON
NORMAL CHROME
INPUT
LEFT RIGHT
OUTPUT
LEFT RIGHT
MIC
PHONES
DOLBY SYSTEM
PIONEER STEREO CASSETTE TAPE DECK MODEL CT-7171
SPEAKERS
OFF A B
BASS
50Hz
100Hz
TREBLE
10kHz
20kHz
VOLUME
LEVEL SET MAIN
-15dB
-30dB
TUNER
PHONO
FUNCTION
PHONO 2
MIC
AUX 1

It is two million years ago. On an African savanna, a strange creature browses for food. He looks something like an ape and also like a man. He walks on two legs—yet his forehead is low and sloping, his jaw thrusts forward. He doesn't know it—but he represents a giant step forward in evolution. For he is the "missing link" between ape and man . . .



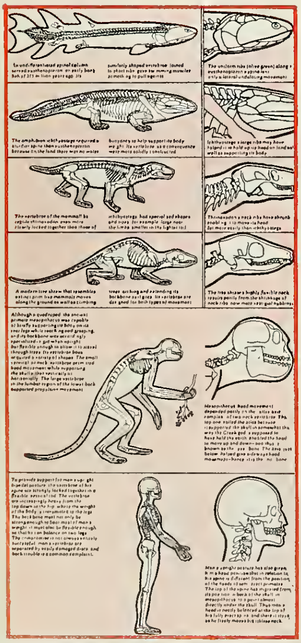
TIME
LIFE
BOOKS

presents a spectacular series . . .

THE EMERGENCE OF MAN

. . . filled with the latest discoveries that now make it possible for you to penetrate the mysterious origins of life and the 20,000 generations of man.

Begin with The Missing Link yours to enjoy free for 10 days



Color-keyed charts like this make the evolutionary processes easy to understand.

Today, that creature who first ventured to raise himself above the other animals no longer exists; he has become you. Unique. Set apart from the 2 million other species living on the planet by a thumb that makes your hand a precision tool . . . by a knee that "locks" you in a comfortable upright position . . . and by your capacity for abstract thought and speech. All this, and more, has enabled your species to dominate the earth. And yet you share, with every other creature that ever lived, the same origins — the same accident that led to the spontaneous creation of the first single-celled algae 3.5 billion years ago.

How did it all happen? What was the evolutionary process that led to Man and his conquest of a harsh and hostile environment? You will find the amazing story in TIME-LIFE BOOKS' new series, THE EMERGENCE OF MAN.

Your introductory volume, *The Missing Link,* shows you the stranger-than-science-fiction world of Australopithecus, the ape man. You'll feel a sense of immediacy and visual adventure in the incredibly lifelike pictorial technique: photo-painting. And a fact-filled text enriched with over 100 illustrations gives you fascinating new answers to age-old questions about the evolution of man.

The answers come from some of the world's most eminent authorities on anthropology, archeology, zoology and paleoanthropology: Margaret Mead; Sherwood L. Washburn; Bernard Campbell and Ralph S. Solecki. They have helped create the most authentic, up-to-date library of books on this subject available today. Once you've experienced the high adventure of *The Missing Link,* you'll eagerly anticipate the rest of the books in the series. In books such as *Life Before Man, The First Men, Cro-Magnon Man* and *The First Cities,* you'll witness the development of all the characteristics that make men human.

For an unforgettable trip into the origins of everything you are and know, take advantage of our introductory offer: Examine *The Missing Link* for 10 days. If it doesn't make you want to own it, send it back. If you do keep it, pay just $5.95 ($6.95 in Canada) plus shipping and handling, and we will then send you other volumes in THE EMERGENCE OF MAN series at the rate of one approximately every other month, on the same free examination terms. You may cancel this arrangement at any time. For your introductory volume, send the order form or write to: Time-Life Books, Dept. 3401, Time & Life Bldg., Chicago, Ill. 60611.

Plus an absolutely Free Wall Chart & Map

Depicts milestones in the evolution of man. Suitable for home, office, or schoolroom. In color, 30¼ x 20 inches, it's yours to keep as a gift for accepting our 10-day trial offer.

The Missing Link

TIME LIFE BOOKS invites you on a spectacular trip to the beginnings of everything you are today . . .

THE EMERGENCE OF MAN

Enjoy the introductory volume

The Missing Link for 10 days free

TIME-LIFE BOOKS, DEPT. 3413
TIME & LIFE BUILDING
CHICAGO, ILLINOIS 60611

Yes, I would like to examine *The Missing Link*. Please send it to me for 10 days' free examination – and a FREE Wall Chart and Map of milestones of evolution – and enter my subscription to THE EMERGENCE OF MAN. If I decide to keep *The Missing Link*, I will pay $5.95 ($6.95 in Canada) plus shipping and handling. I then will receive future volumes in THE EMERGENCE OF MAN series, shipped a volume at a time approximately every other month. Each is $5.95 ($6.95 in Canada) plus shipping and handling and comes on a 10-day free examination basis. There is no minimum number of books that I must buy and I may cancel my subscription at any time simply by notifying you.

If I do not choose to keep *The Missing Link*, I will return the book within 10 days, my subscription for future volumes will be canceled and I will not be under any further obligation. I may keep the free Wall Chart and Map in any case.

Name____________________________________
(please print)

Street____________________________________

City______________ State______________ Zip________

Residents of Canada: Mail form in envelope.
Schools and Libraries: Order Library Style Bindings from Silver Burdett Co., Morristown N.J. 07960. Eligible for Titles I, II funds.

Natural History

BUSINESS REPLY MAIL
No postage stamp necessary if mailed in the United States

FIRST CLASS
PERMIT NO. 22
CHICAGO,
ILLINOIS

Postage will be paid by

TIME
LIFE
BOOKS

Time & Life Building
Chicago, Illinois 60611

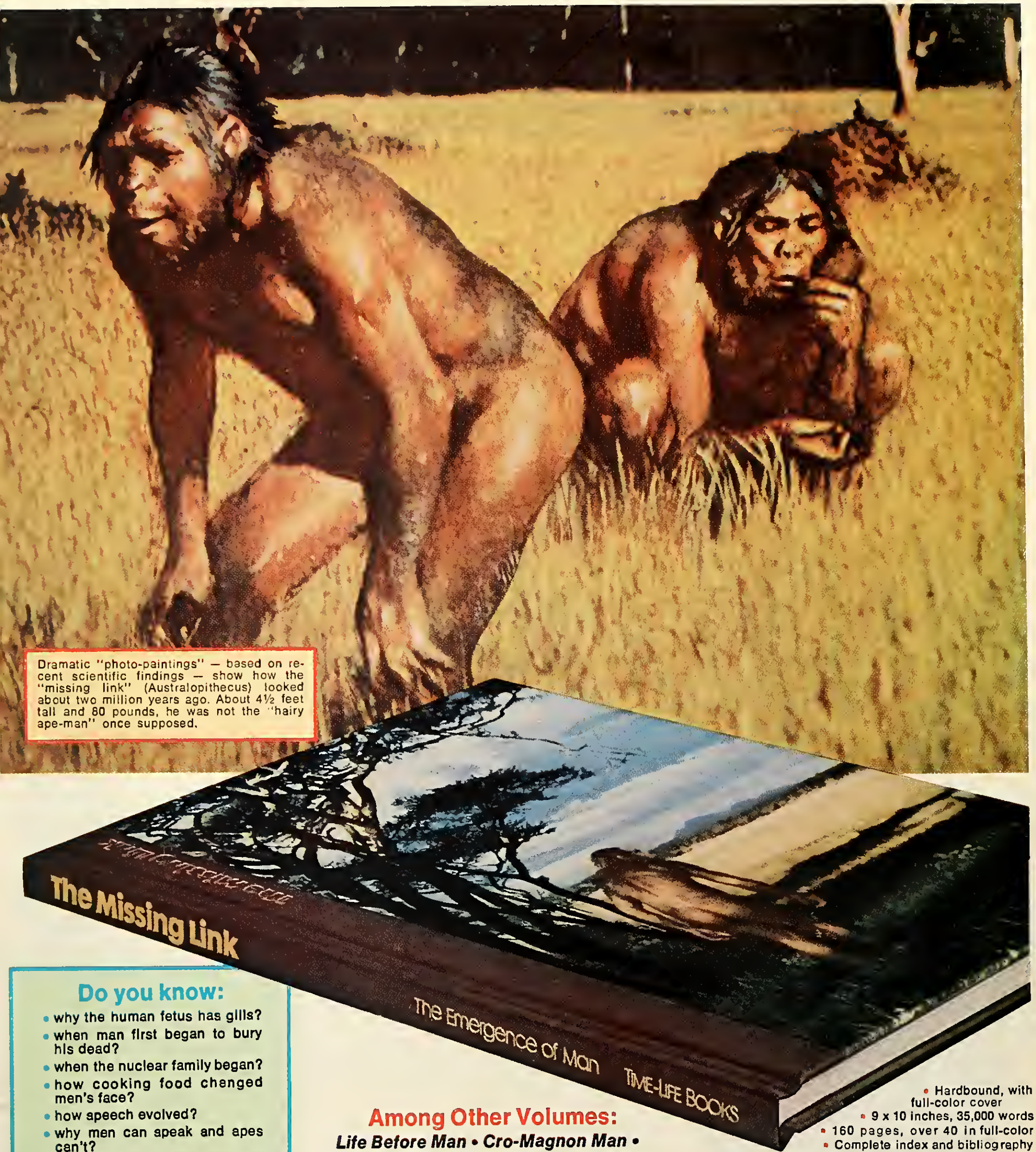
And, as your introduction to
THE EMERGENCE OF MAN
yours to enjoy for
10 days free...
The Missing Link

The Missing Link
The Emergence of Man
Time-Life Books

Plus an absolutely FREE
Wall Chart and Map

depictin
man's
significa
"firsts"

TIME
LIFE
BOOKS


The Missing Link
The Emergence of Man
TIME-LIFE BOOKS

Dramatic "photo-paintings" — based on recent scientific findings — show how the "missing link" (Australopithecus) looked about two million years ago. About 4½ feet tall and 80 pounds, he was not the "hairy ape-man" once supposed.

Do you know:

- why the human fetus has gills?
- when man first began to bury his dead?
- when the nuclear family began?
- how cooking food changed men's face?
- how speech evolved?
- why men can speak and apes can't?
- what dinosaurs were really like and what enabled them to rule the earth for 135 million years?
- what the latest findings are on "the missing link"?
- in what way Neanderthal Man was "religious"?
- if any creatures except man use tools?
- whether or not there are still Neanderthals among us?
- if the land near the South Pole could once have been sub-tropical?

- Hardbound, with full-color cover
- 9 x 10 inches, 35,000 words
- 160 pages, over 40 in full-color
- Complete index and bibliography

Among Other Volumes:

Life Before Man • Cro-Magnon Man • The Neanderthals • The Monument Builders

Life Before Man
Cro-Magnon Man
The Neanderthals
The Monument Builders

More oil from

How Exxon is squeezing additional oil out of a 55-year-old field.

A popular myth has it that oil is found in large underground lakes or pools. Actually, when oil and natural gas are discovered they are inside sedimentary rock. They are trapped in the tiny pores of limestone or sandstone as far as five miles underground.

Usually, when a well is drilled into oil-saturated rock, natural underground pressures force the oil to *flow through the rock* to the well and then to the surface.

However, in many oil fields these natural pressures are not strong enough to move the oil to the well. Or, over time, they may have diminished to the point where they must be supplemented by additional pressure. This additional pressure is provided by "secondary recovery" methods.

Sample drilling cores taken from oil-saturated rock formations in Alaska, Texas and Saudi Arabia. Oil and gas must come from and flow through rock like this before they reach the well bore.

Forcing water deep into the oil-bearing rock.

The most widespread secondary recovery method in use throughout the oil industry is *waterflooding,* which was introduced over 30 years ago. Water is pumped into the oil-bearing rock to flush out more of the oil than would be produced by natural, or primary forces.

On the average, natural pressures move only about 15-20% of a field's oil from the underground rock up to the surface. By using secondary recovery technology, the final yield can be increased to an average of about 35%.

The Hewitt Field—a case in point.

The Hewitt oil field, discovered in 1919, near Ardmore, Oklahoma, is operated by Exxon and several other companies. Originally, this field produced nearly 30 thousand barrels of oil a day. However, the depletion of natural underground pressures gradually reduced Hewitt's production to the point where the field needed waterflooding.

In 1969, Exxon and other owners began a cooperative secondary recovery waterflood project, which has since cost about $20 million.

Engineers now estimate that the Hewitt field ultimately will produce 35% of the original oil in place. Without the use of waterflooding, total recovery had been estimated at only 20%.

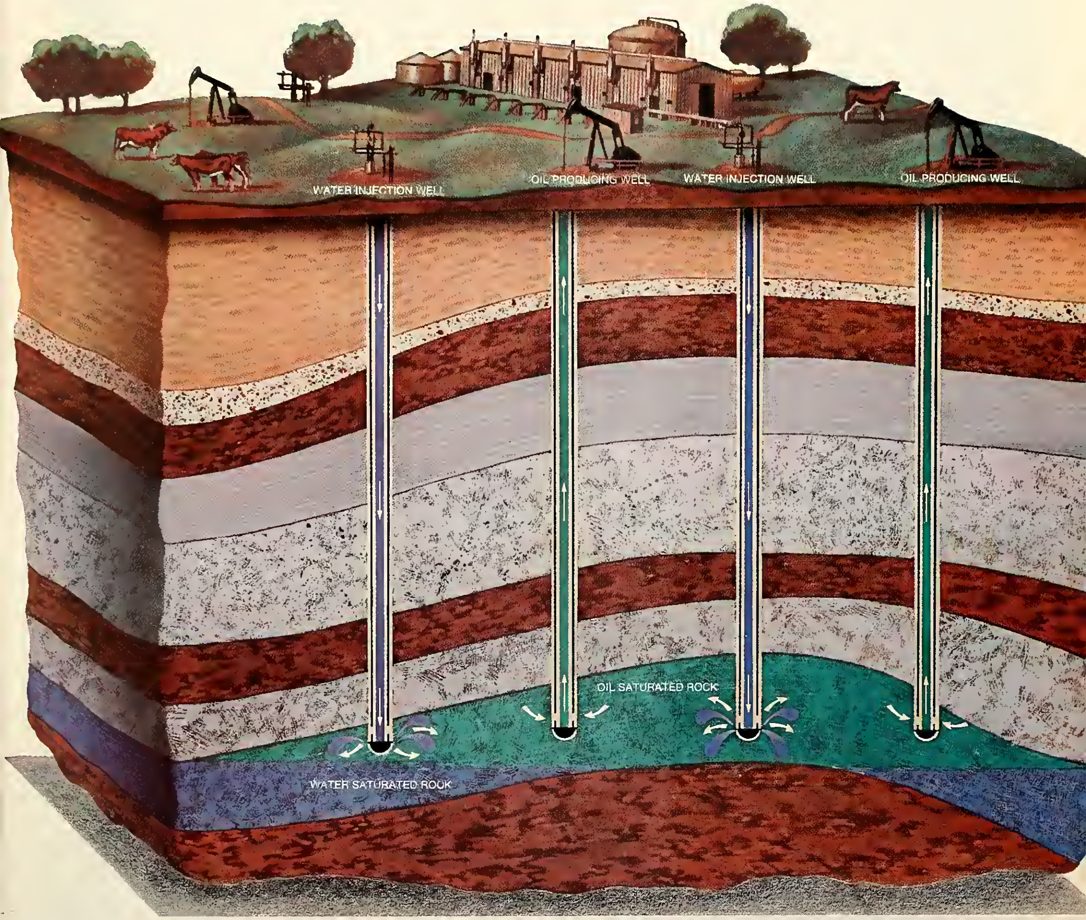
Sometimes, but not at Hewitt, natural gas is injected instead of water. However, the efficiency of waterflooding usually makes it more attractive.

An experiment using heat and subterranean "detergents."

Even after an oil field is subjected to secondary recovery techniques, such as water and gas injection, a large percentage of the oil still remains locked in the pores of the rock. So for many years, Exxon has been experimenting with tertiary recovery methods designed to recover more of this oil.

In one experimental process, a "detergent" or surfactant is pumped into the rock. This agent works like a laundry detergent that removes oil from a shirt—it flushes out the droplets of oil which still remain in the pores of the rock. In some cases, particularly where the oil is thicker, sometimes nearly the consistency of molasses, steam injection also is being tested. The hot steam heats the oil, making it flow more freely.

old wells.


WATER INJECTION WELL
OIL PRODUCING WELL
WATER INJECTION WELL
OIL PRODUCING WELL
OIL SATURATED ROCK
WATER SATURATED ROCK

Artist's conception of the Hewitt oil field located near Ardmore, Oklahoma. Large quantities of water are being injected into the oil-saturated rock to significantly increase the oil production.

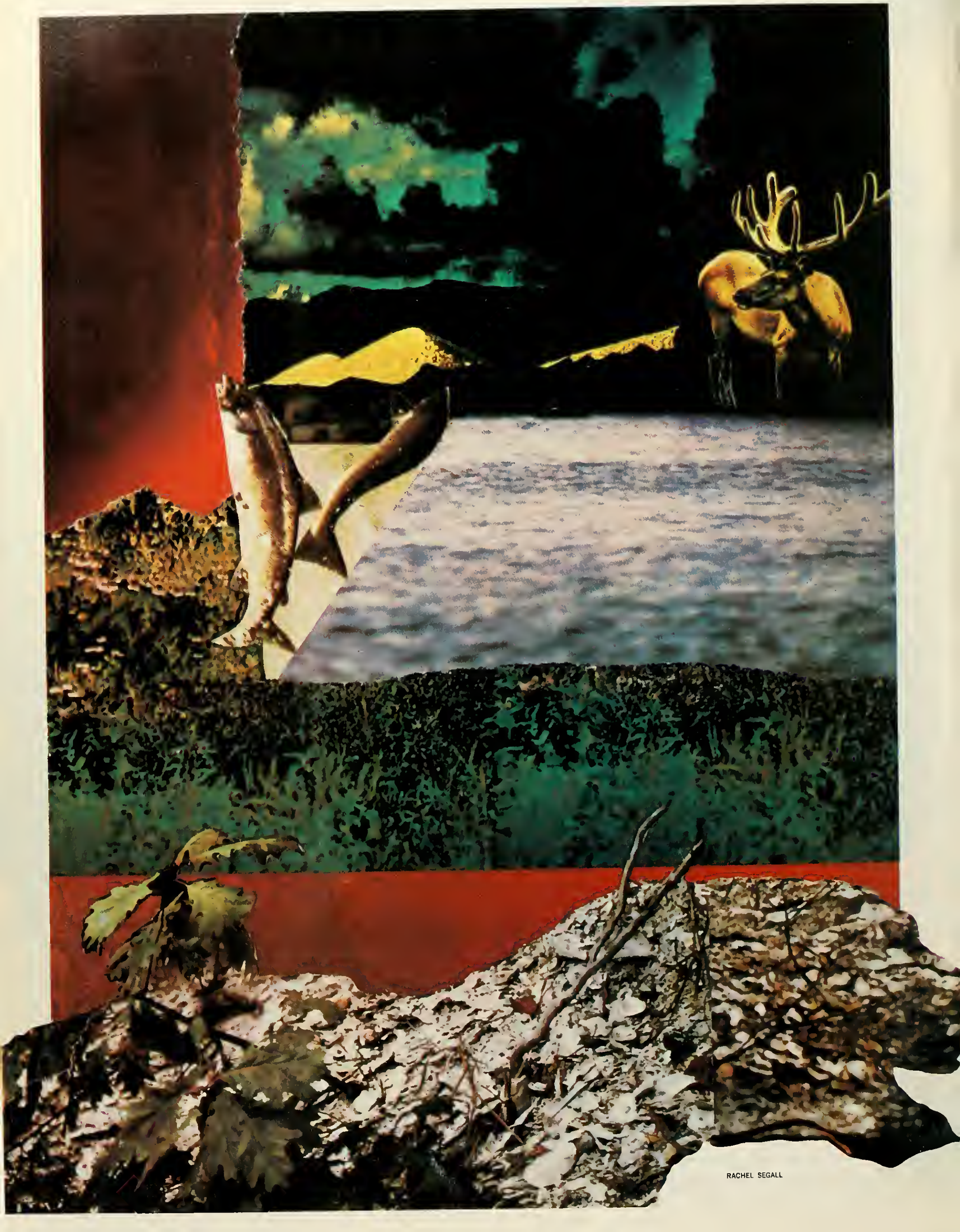
In perhaps the most dramatic oil-recovery technique, air is injected into the rock formation holding the oil. This injected air supports controlled underground combustion, which heats the oil, causes it to flow more readily and drives it to the well.

In addition, Exxon is testing and evaluating several other tertiary techniques.

A realistic look at the future.
To date, about 450 billion barrels of oil have been found and documented in the United States. Even after additional recovery efforts, like the waterflooding at Hewitt, are applied, some 300 billion barrels of this oil will still remain locked in the pores of rock. Today, there is no way to recover all of this oil.

But scientists believe that experimental "tertiary" techniques like "detergents" and combustion, could someday produce a significant amount of additional oil which America will need in the years ahead.

EXXON



RACHEL SEGALL

The Changing Prey of Maine's Early Hunters

After centuries of pursuing whales, caribou, and moose, the Indians assured their welfare by exploiting a European weakness for beaver pelts

by Dean Snow

The Red Paint cemeteries of Maine are among the oldest elaborate prehistoric burial sites known in North America. Discovered in the middle of the nineteenth century, when interest in American antiquities was becoming popular, the Red Paint graves are characterized by the large quantities of red ocher (powdered hematite) lining the burial pits.

Red ocher, with its suggestion of blood and the life that blood sustains, was a popular substance used throughout the prehistoric world wherever it occurred in accessible natural deposits. Smeared on the bodies of the living and the dead alike, applied to the linings of graves, or used as a ceremonial pigment in any number of ways, red ocher was unmatched in popularity by any other natural coloring. In Maine, the primary source of the substance was a mountain of hematite now called Katahdin Iron Works.

The past decade has brought a resurgence of interest in the Red Paint complex and the prehistoric society that sustained it. More intriguing than the burial ground site itself are the archeological discoveries that provide clues to the type of society that existed there.

Archeologists agree that the Indian population of Maine and the Canadian Maritime Provinces must have been greater during the time of the Red Paint complex than was usually the case in late prehistoric times. But there is less agreement about the subsistence system that supported such a population or the probable causes for its eventual breakdown.

Recent excavations at three sites have been particularly important for archeologists probing the deeper meanings of the complex. One of these is the Hathaway site in Passadumkeag, Maine, discovered and first excavated by Warren K. Moorehead in 1912, where I carried out the last of three separate archeological excavations. The second is the Cow Point site in New Brunswick, and the third is located at Port au Choix near the northern tip of Newfoundland. Together, the three sites cover the known range of the burial complex. Radiocarbon dating of all three sites indicates that the complex began about 5,000 years ago in Maine and spread northward. Thirty-seven hundred years ago, it was already waning in the south, and it gradually disappeared in the north after that date.

At the Port au Choix site, the Indians dug graves in beach sand sprinkled with tiny shell fragments. The shells neutralized the natural acidity of the soil and this, in turn, allowed the unique preservation of human skeletal material. The shells also facilitated the preservation of types of artifacts that have perished in other Red Paint cemeteries.

Long bone spear points, similar to the slate points found at other sites, were discovered at Port au Choix. Amulets and bone harpoon heads also occur, as do other fragile artifacts of bone and wood. Heavy stone ax and adz bits, which along with chipped stone points are often the only artifacts found in a Red Paint site, turned up as well.

The artifacts at Port au Choix

When the two images become one, you're in perfect focus. Only Sankyo Hi-Focus has it.

Most movie cameras have ground glass focusing or guess-the-distance scales. Frankly, they're darned hard to focus.

But then, there's Sankyo Hi-Focus. A whole series of automatic movie cameras with big, bright through-the-lens superimposed rangefinder image that virtually guarantees needle sharp movies. You can focus precisely, in seconds, even zoom in on a moving subject. As you look through the viewfinder, the subject appears as two images. Just turn the zoom lens until the two images become one...and you're in perfect focus. It's that simple. The closest thing to automatic focusing! There's a Sankyo Hi-Focus movie camera with your kind of features and your kind of price tag at your camera dealer now.

Sankyo

Sankyo Seiki (America) Inc.
149 Fifth Avenue, New York, N.Y. 10010
West Coast Branch:
13000 S. Athens Way, Los Angeles, Calif. 90061

strongly suggest a cult carried out by people who subsisted at least in part on marine hunting. Many of the weapons included as grave offerings would have been most appropriate for use against large marine animals.

Archeologists excavating habitation sites along the Maine coast of the same time period as the Red Paint complex have found the remains of swordfish, blackfish (*Globicephala*), and porpoise. The last two are mammals that sometimes become stranded on beaches, but the swordfish is an ocean fish that rarely floats to shore. All three can be formidable game animals, and to hunt them, the Indians must have been both skillful and well equipped.

Late prehistoric Indians in the northeast used birchbark canoes, and their skill with the light craft is legendary. The high frequency of ax and adz bits in Red Paint cemeteries, however, argues that the Maine Indians of 5,000 years ago built dugout canoes. The size of their marine game suggests that these canoes must have been large dugouts, perhaps the size of the forty-foot-long, ocean-going canoes used along the coast of Alaska and British Columbia in the eighteenth century.

During the warm months of the year, the Maine coast hunters harpooned swordfish and marine mammals as they idled at the surface. Wounded animals were probably allowed to expire at the end of line tied to the harpoon point.

In similar hunting, historic Eskimo tethered their harpoon lines to skin floats in order to keep their frail boats from being torn apart by the struggling animals. But skin floats, which were not used along most sections of both the east and west coasts of North America, would not have been necessary where large, sturdy dugouts were used.

Stone plummets, some with five-inch diameters, found in the Red Paint graves indicate that these people were also fishermen. On the northeast coast, seasonal runs of salmon, alewives, and eels occur sporadically from spring until fall. Remains of these fishes and pieces of fishing gear are often found in coastal burial sites. The remains of the coastal habitations of 4,500 years ago, however, are usually under, not in, shell middens, indicating that these people did not exploit the shellfish resources popular in later centuries.

The findings at the Port au Choix site have led archeologist James Tuck to suggest that the winter hunting pattern in Newfoundland during the life of the Red Paint complex centered mainly upon caribou herds. The woodland caribou still lives in Newfoundland's interior, feeding on the lichens and other foods that grow in the mature spruce–fir forest.

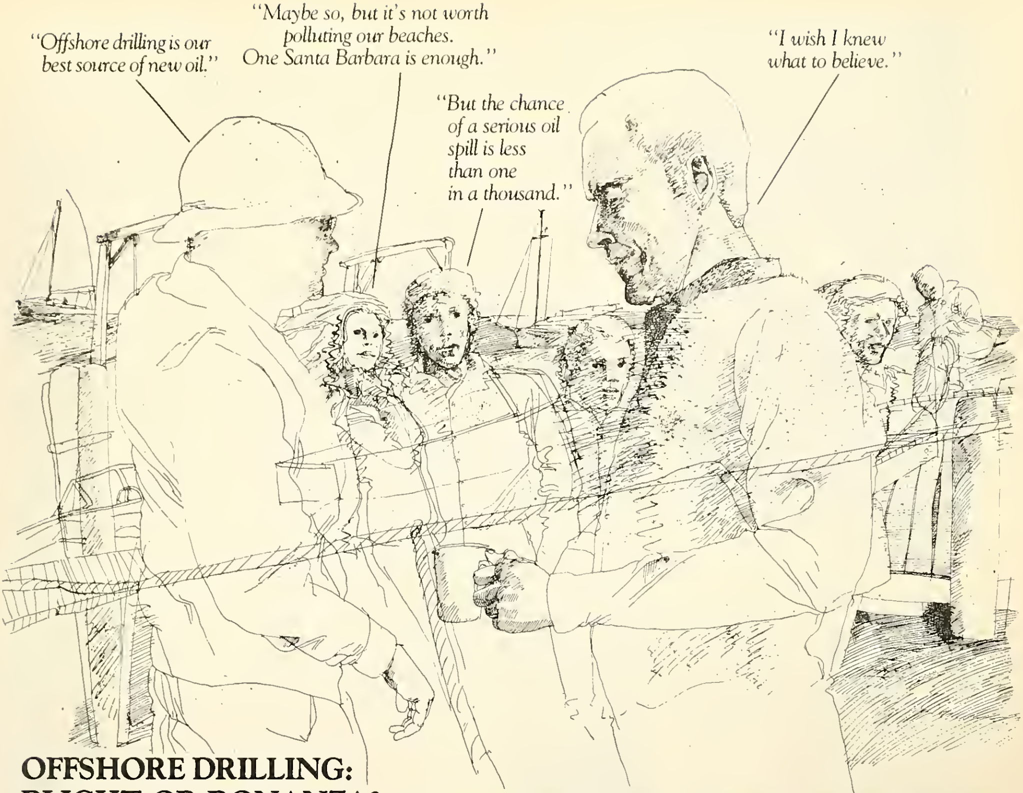
Historically, caribou also lived in the upland interior forests of Maine and New Brunswick, but occurred only sporadically to the southwest. Five thousand years ago caribou were probably widespread throughout the area. Archeological preservation is poor, however, and in the absence of direct evidence of caribou hunting, some archeologists remain skeptical.

The next-best evidence would be indications from fossil pollen analysis that the area's interior forests of 5,000 years ago were suitable for the support of large caribou populations. Pollen specialists at the University of Maine's Quaternary Institute are still working on this problem.

Marine hunting in the summer and a hypothetical counterpart of caribou hunting in the winter offer an explanation for the organization of the prehistoric Indians of the Red Paint complex.

The northeastern Indians of 5,000 years ago lived in a period that is usually labeled "Archaic." Subsistence involved neither the extinct big game of the Pleistocene nor any of the domesticated plants that were later adopted. Nevertheless, the seasonal hunting pattern I have suggested would have required relatively larger hunting bands than were the rule 1,200 years later.

The Tlingit of Alaska went to sea in forty-five-foot canoes that could hold as many as sixty persons, although fewer would be the rule if only hunters were aboard. In some parts of the northern subarctic, hunting bands were large enough to construct miles of log barriers and enclosures for impounding caribou. The harvesting of seasonal fish runs was also a subsistence activity that the Indians could efficiently carry out in relatively large teams. These analogies all substantiate the infer-


"Offshore drilling is our best source of new oil."
"Maybe so, but it's not worth polluting our beaches. One Santa Barbara is enough."
"But the chance of a serious oil spill is less than one in a thousand."
"I wish I knew what to believe."

OFFSHORE DRILLING: BLIGHT OR BONANZA?

Off our shores may be enough oil and gas to take care of an important part of America's petroleum needs for many years to come.

Conoco believes we should be developing that resource full speed.

But our governments—federal and state—are holding up exploration in some areas because of concern for the environment. And where governments are ready to move they are frequently stopped by lawsuits brought by environmental groups.

Here are the facts:

Of 18,000 wells drilled off our shores, only four resulted in oil spills of any consequence.

Technology has improved, and the risks of spills are less than ever.

Oil companies currently hold leases on about three percent of America's offshore continental shelf, much of it in the Gulf of Mexico. From these offshore areas we are now getting about 18 percent of domestic oil production.

It usually takes millions of dollars to explore one offshore site; and, if successful, from two to seven years to bring an established field into full production.

Conoco believes that the environmental risks are now so well in hand that the industry should be allowed to step up its search for offshore oil. This is one of the best ways we have to help reach America's goal of near self-sufficiency in energy.

If you'd like to be more informed on both the pros and the cons, write Conoco and we'll send you the following material: a booklet explaining and supporting offshore drilling published by the American Petroleum Institute; and a report of an offshore drilling conference debating both sides of the issue, sponsored by the New York Ocean Science Laboratory.

Write Conoco, Dept. B49, GPO Box 29, New York, New York 10001.

Continental Oil Company CONOCO

This is the Time of the Dolphin.
Shown actual size

Dolphin Pendant by International Silver.

—in Sterling Silver or 24kt. Gold Electroplate.

The Dolphin: the sea's most graceful, most mysterious creature. Are dolphins as intelligent as Man? This one is very, very bright—it's made of gleaming sterling silver, or sterling electroplated in 24kt. gold. Comes with a chain and also a pin attachment so it can be worn as a pin or pendant.

Dolphin in sterling silver with chain electroplated in tarnish-proof rhodium, $12.50. Sterling dolphin with chain, both electroplated in 24kt. gold, $20.00.

At fine stores or order direct.

**FOR PHONE ORDERS,
call 800-243-3755 toll-free
(in Connecticut, call collect 235-5155)
and give us your charge card number.
TO ORDER BY MAIL, use this coupon.**

© 1974 International

American Archives, Dept. DD-9
122 Charles Street, P.O. Box 1776
Meriden, Connecticut 06450

Please send me, postpaid, the following "Dolphin" pendants:
_____Sterling Silver @ $12.50
_____Sterling electroplated in 24kt. gold @ $20.00

Name____________________

Address____________________

City__________State________Zip________

CHECK ONE:
☐ I enclose check or money order payable to American Archives.
☐ Charge my purchase to:
☐ Diners Club ☐ American Express
☐ Master Charge ☐ BankAmericard

Account #____________________

Expiration Date____________________

Signature____________________

Total Amount enclosed or charged $________
No C.O.D.'s. Conn. residents add sales tax.
Offer good in U.S.A. only, except where prohibited or restricted by law.

ence that Maine once supported large hunting bands.

Although the Red Paint complex is one of the oldest burial cults in North America, evidence from other parts of the northeast and the Great Lakes region suggests that similar cults were functioning there at about the same time. Cemeteries of equivalent age, which contain artifacts skillfully wrought from nuggets of native copper, are scattered around Lake Superior. The Red Paint sites show that grave offerings were not made in a set pattern. This suggests that in each case they were the property of the deceased or the contributions of a few close relatives. The Archaic Indians of the northeast thus probably lived in societies of equals, where social standing depended on individual merit, age, and sex.

The Red Paint complex cult did not appear out of place or before its time. Rather, it is a striking expression of what was probably a widespread ideological phenomenon in the northern part of the eastern woodlands, extending all the way to the Old Copper cemeteries of Lake Superior. This indigenous religiosity later contributed significantly to the emergence of Adena and Hopewell ceremonialism in what is now the Midwest, the first signs of which appeared about 3,500 years ago.

The environmental system, which promoted the emergence and maintenance of the Red Paint cult, also promoted its eventual demise. The balanced schedule of marine and inland hunting and fishing provided Archaic people with an adequate and dependable subsistence. But the environment changed, and the consequences of that change were serious. As the vegetation increased, open lakes slowly evolved into bogs, a process that began with the melting of the last glacial ice and continues today. As the climate continued its slow evolution, Maine and the Maritime Provinces gradually became warmer. Here again the details remain unclear, and we must await the results of fossil pollen analysis. Nevertheless, scientists do know that by 3,700 years ago the forests of the region had altered their compositions in response to the shifting climate.

Maine was, and still is, a zone of ecological stress, where the spruce–fir forests meet those of white pine–hemlock and beech–birch–maple. The area is marginal for all three forest types and the biotic communities they represent. A small shift in climate can cause drastic shifts in forest margins under these conditions. Due to climatic changes prior to 3,700 years ago, the large caribou population, which had been well adapted to Maine's forest environment, declined gradually but significantly.

The marine environment was evolving as well. Sea levels along the coasts of Maine and the Maritimes have been slowly rising for several thousand years. At the same time, coastal waters have been steadily cooling. These changes may have had an adverse effect on the local availability of swordfish and other marine game.

All the environmental shifts together upset the ecological adjustment of Archaic Indian hunting and fishing. Changes in the interior favored the solitary moose, whose presence greatly affected winter hunting patterns. Since moose do not gather in large herds, prehistoric hunters had to pursue them in small family bands. Slowly, the social organization drifted toward its late prehistoric form, in which population size was determined, not by the plenty of summertime, but by the rigors of the leanest month. January, the "moon of hard times," was a month that many did not survive.

Even if one or two parts of a scheduled seasonal round remain viable, the collapse of another can have serious consequences for the whole system. Archeologists are investigating the possibility that swordfish may have become scarce off the coasts of the northeast, but even had they remained numerous, the social units that were traditionally mobilized to hunt them had been eroded by the shift in winter hunting practices.

I think this is one reason why subsistence practices during summer residence along the coast gradually shifted to shellfish gathering and fishing. The large dugouts of earlier centuries were no longer adaptive, and were gradually replaced by birchbark canoes. These lightweight craft, which could penetrate the upper reaches of swift streams, were easily managed by small family hunting bands. Taken as a whole, it was a systemic change for which we can point to no clear-

Great Awards Collection

Now audition Deutsche Grammophon's
triple-award-winning recording

Mozart's Six Greatest Symphonies

with Karl Böhm conducting
the Berlin Philharmonic

Free for 10 days!
And there's no obligation to buy!

Keep all three for less than the price of one!

Mail this postcard today!

NATURAL HISTORY

DETACH HERE AND MAIL TODAY!

MOZART KARL BÖHM

Q58

Please send for my free audition the triple-award-winning recording of Mozart's Six Greatest Symphonies by Karl Böhm. I may return it after ten days and owe nothing, or keep it and pay only $6.98 for all three Deutsche Grammophon records, plus small postage/handling charge (sales tax extra, where required). This is all three records for less than the price of one!

I will also receive a free ten-day audition each month of another award-winning recording of great music. For every one of these records I buy at your members' price (always less than suggested retail), I may also choose one record at half price from your special list. I am not obligated to buy any minimum number of records. I may cancel my membership at any time.

Name

Address

City State Zip

19110/Q58

Send no money. Mail card today!

Offer limited to the U.S. and its possessions. Offer expires 1/31/75
Limit: One membership per household—only new members eligible.

BUSINESS REPLY MAIL
No postage stamp necessary if mailed in the United States

FIRST CLASS
Permit No.
1954
Great Neck, N.Y.
11025

Postage will be paid by

Great Awards Collection
175 Community Drive
Great Neck, New York 11025

—DETACH HERE AND MAIL TODAY!—

Mozart's Six Greatest Symphonies

Magnificent performances
by Karl Böhm and
the Berlin Philharmonic Orchestra

Winner of three
major international awards

Superbly recorded
by Deutsche Grammophon

Pressed in Europe to
highest quality-controlled standards

Mail this postcard today!

Discover for yourself why this Karl Böhm recording has won three major awards!

Enjoy MOZART'S SIX GREATEST SYMPHONIES in your home for 10 days free. All three Deutsche Grammophon recordings yours for less than the price of 1!

Mozart – music's greatest natural genius!

Wolfgang Amadeus Mozart – divinely gifted beyond any other musician who ever lived! And into his six greatest symphonies he poured a multitude of his most astonishingly beautiful, incredibly moving inspirations!

Symphony No. 41, "Jupiter"
Symphony No. 40 in G-minor
Symphony No. 39 in E-flat
Symphony No. 38, "Prague"
Symphony No. 36, "Linz"
Symphony No. 35, "Haffner"
Extra! Symphony No. 32

Now you are invited to hear these miraculous works in their finest recording . . . interpreted with extraordinary empathy by Karl Böhm . . . played to perfection by the Berlin Philharmonic Orchestra . . . captured in unsurpassed stereo realism by Deutsche Grammophon. So outstanding is this recording that it has won *three* of the music world's most eagerly sought honors: the Grand Prix International du Disque, Edison Award and Deutsche Schallplatten Prize!

Now enjoy and keep these 3 superb albums for less than the price you'd pay for 1!

Because Mozart's Six Greatest Symphonies by Karl Böhm has met with almost unprecedented acclaim, it has been chosen to introduce you to the Great Awards Collection, a totally new concept in home listening. You may enjoy all six masterpieces, on three superb-quality, imported records, for 10 days absolutely *free*. Then keep all three if you wish, for only $6.98 *(that's less than the price you'd pay for just one record)! Simply mail the attached coupon today.*

Collect the world's greatest music – only in award-winning albums!

As a member of the Great Awards Collection you will receive only the finest recordings of prize-winning concert performances by top orchestras, conductors and soloists. Distinguished jurors each year select, from the hundreds of classical releases, the "golden few" that will be offered to members of the Great Awards Collection. Every month you'll enjoy free 10-day audition privileges on each award-winning single LP. Of course, you have the option of keeping or returning each one so you'll never waste a penny on disappointing purchases!

Special half-price bonus offer saves you money!

In addition to great music, you'll enjoy great savings with our half-price plan. For every record you buy you may choose another one from a list of award-winners and other critically acclaimed LP's and pay just half the regular members' price! An economical way to build your library of superb classical recordings.

How many records are you committing yourself to buy when you return the attached coupon? *None at all!* Even your introductory set of *Mozart's Six Greatest Symphonies* comes to you *on approval*. Audition it free for ten days, then either return it – or keep it for only $6.98 for all three records, (plus a small postage/handling charge and sales tax where required).

Here at last is the ideal way to acquire, in easy stages, a connoisseur's record library without wasting a penny on disappointing purchases. You listen at home to every award-winning selection before deciding whether to buy it! Please act today! Begin your money-saving, no-obligation membership in the Great Awards Collection by mailing the attached coupon for your free trial, with 3 for less than the price of 1 purchase option of Mozart's Six Greatest Symphonies – a recording for the ages!

Seven ways the Great Awards Collection helps you enjoy fine music more than ever!

1. Greatest music by the immortal composers.
2. A major, award-winning recording each month.
3. Superior imported LP's – silent surfaces.
4. Free ten-day trials of all selections.
5. Big savings through Half-Price Bonus Plan.
6. No obligation to buy – no minimum purchase.
7. Money-saving introductory offer.

Send no money now – Mail coupon TODAY!

Q58

Listen for 10 days free.
Keep all 3 for less than the price of 1!

Great Awards Collection
175 Community Drive
Great Neck, N.Y. 11025

Please send for my free audition the triple award-winning recording of *Mozart's Six Greatest Symphonies* by Karl Böhm. I may return it after ten days and owe nothing, or keep it and pay only $6.98 for all three Deutsche Grammophon records (plus a small postage/handling charge and sales tax where required).

I will also receive a free ten-day audition each month of another award-winning recording of great music. For every one of these records I buy at your members' price (always below suggested retail), I may also choose one record at half that price from your special list. I am not obligated to buy any minimum number of records. I may cancel my membership at any time.

NAME (please print) ______________________

ADDRESS ______________________

CITY ______________________

STATE ____________ ZIP ____________

19109/Q58

Offer limited to the U.S. and its possessions. Offer expires 1/31/75
Limit: One membership per household – only new members eligible.

Whatever your dream of India, there's an Air-India tour to make it come true.

If India makes your imagination take flight, let Air-India fly you there as no one else can on tours such as these:

India Highlights Tour. A fully-escorted 22-day deluxe tour of Delhi, Jaipur, Agra, Khajuraho, Banaras, Kathmandu, Calcutta, Madras, Madurai, Trivandrum, Kovalam Grove, Bombay, and Rome.

Trinity Tour of India. A 25-day, fully-escorted holiday. You'll be fascinated by these three countries: India, Nepal, and Ceylon.

From the Ganges to the Nile. For 29 days, you'll be escorted through not only India, but intriguing Africa, too. The famous game parks in Kenya and Lake Manyara. Tanzania. Nairobi.

The Air/Sea Discovery. A 9-day sea cruise on the elegant MTS Jupiter. You'll sail from Bombay to Colombo, the Laccadive Islands and Goa. Then choose from three different land itineraries.

See your travel agent or Air-India. And make your special dream of India a reality. With a dreamy tour from Air-India.

AIR-INDIA
666 Fifth Avenue, New York, N.Y. 10019

We work all day
to make your night with us a dream.

cut causes other than the subtle environmental changes that made some old culture traits a bit less adaptive and some new innovations more so.

As the cultural system adjusted to the changed ecological balance, it began to take on many of the characteristics of late prehistoric times. Summer maritime practices included shellfish collecting in place of marine hunting. Small family bands pursued moose and engaged in trapping during the winter. Little in the new adjustment encouraged the continued manufacture of the specialized tools that previously made up Red Paint grave offerings. The advent of birchbark canoes put an end to the need for heavy ax and adz bits, and only relatively few, stunted examples were made in later prehistoric times.

The spears and harpoons that had previously been necessary pieces of hunting equipment were replaced by newer forms. The old pattern was gone, and so were the artifact types that had given it material identity. It is no surprise that the Red Paint burial complex—the ideological component—waned as well. The use of red ocher in graves continued for many centuries, but burial forms changed and associated artifacts are scarce.

The environmental conditions that were relatively new to Maine and the Maritimes 3,700 years ago were already established in southern New England. The sudden appearance in Maine at about that time of southern-type spear points and burial forms indicates that at least part of the human ecological readjustment was the result of immigration from the south. The older residents adapted, but even as they did so, they found themselves displaced northward. Perhaps only the Indians of the Maritime Provinces and Newfoundland can count themselves descendants of the people that maintained the Red Paint cult for 1,300 years.

Much of the archeological evidence of the last 3,700 years in Maine comes from middens of shell refuse. The shell heaps that dot the coastline today accumulated slowly, some of them had reached a depth of fifteen feet or more by the year 1600. Indeed, the bulk of the shell refuse has sometimes caused us to overestimate the importance of this food resource to late prehistoric Indians. Little other prehistoric refuse has been preserved as well as shells. Twentieth-century clam diggers know that less than one-quarter of the total weight of common clams (*Mya arenaria*) is edible meat. For quahogs (*Venus mercenaria*) and oysters (*Ostrea virginica*) even less of the total weight is edible.

In contrast, more than half the total weight of land animals can be consumed. The bone remains found by archeologists represent only 5 percent of the total live weights of the animals, or a tenth of the edible meat. The ratio is reversed for shellfish, and just as important, their bulky shells are preserved under conditions that would destroy bone and plant remains. Finally, shell middens are specialized coastal sites, where shellfish gathering was the primary subsistence activity.

The oyster shell middens at Damariscotta, Maine, are the largest in the state and among the most extensive anywhere on the Atlantic coast. The largest of them were long ago hauled away for commercial purposes, but the remaining heaps are preserved under state protection. By the end of the prehistoric period (A.D. 1600) as many as 198,600,000 oysters may have accumulated in the heaps. That is an impressive number, but if it is divided by the 1,600 years it took them to accumulate, and divided again by the estimated 800 Indians of the area, it comes to only 155 oysters per person per year.

When all the factors of resource productivity and preservation of evidence are taken into account, the later prehistoric subsistence pattern appears to have been rather well balanced. The Indians hunted moose and trapped beaver. They gathered shellfish and netted, hooked, or speared various species of migratory fish. Birds, particularly waterfowl, were taken in season, and berries and groundnuts were gathered as well.

The late prehistoric cultural system lacked some of the exotic trappings of a system that thrived 4,500 years ago, but it was a system that was well adjusted to the conditions of the times. Over the past 2,000 years, some of the elements of a more settled life became available to the Indians of Maine. Pottery was introduced from neighboring regions to the southwest and was

FREEDOM OF WORSHIP
FREEDOM FROM FEAR
FREEDOM FROM WANT
FREEDOM OF SPEECH
Actual size of ingot
1¾" = 2¼"

THE HAMILTON MINT PROUDLY PRESENTS

NORMAN ROCKWELL'S FOUR FREEDOMS

A Memorable New Limited Edition of Pure 1000 Grain Silver Ingots The Largest and Heaviest Ever Struck by The Hamilton Mint

A Strictly Limited Edition.

Orders must be postmarked
by November 30, 1974.

LIMIT: ONE SET PER SUBSCRIBER

NORMAN ROCKWELL, by far America's greatest and best loved artist, has for fifty years brought joy to millions of Americans young and old.

Now, by exclusive permission of The Saturday Evening Post, The Hamilton Mint is extremely proud to issue, and thus preserve, forever, in stunningly beautiful silver ingots, the greatest of all his works. "The Four Freedoms."

Rockwell created the original masterpieces during World War II in a burst of patriotic fervor. They depict those great values held very dearly in the hearts of all Americans. And they are just as truly inspiring now as they were then.

The Hamilton Mint believes that in these troubled times, our nation sorely needs to rededicate itself to these great beliefs: *Freedom of Speech, Freedom of Worship, Freedom from Fear* and *Freedom from Want*. So with great pride, we present this magnificent collection.

Rockwell Talks About "Four Freedoms"

"When Roosevelt and Churchill issued their famous Atlantic Charter, with its Four Freedoms proclamation, I tried to read it . . . but I hadn't been able to get beyond the first paragraph. The language was so noble. Then one night . . . I thought, that's it! I'll illustrate the Four Freedoms using my Vermont neighbors as models. I'll express the ideas in simple, everyday scenes . . . in terms everybody can understand."

Norman Rockwell depicted these great beliefs with his own inimitable and unique brand of genius. *Freedom of Speech* is portrayed by a man unafraid of reprisal as he speaks his mind at a town meeting . . . *Freedom of Worship* shows all people free to worship according to their own dictates . . . *Freedom from Want* is depicted by a family sharing their Thanksgiving meal together and *Freedom from Fear* is shown tenderly by a mother and father as they snuggle their children safely in bed for the night. Rockwell himself says "The Four Freedoms was the best idea I ever had."

Quotations from "My Adventures As An Illustrator" by Norman Rockwell

A Strictly Limited First Edition

This First Edition will be of special interest to knowledgeable collectors because they represent Rockwell's greatest work and traditionally, first editions have always been the most valued. To insure the integrity of this edition, ingots will be struck to fill orders postmarked by November 30, 1974. Once those orders are filled, no more first edition ingots will ever be minted.

An Exclusive Treasury

Each beautifully sculptured ingot will measure 1¾" x 2¼" and will contain 1000 grains of .999 fine silver, the purest and finest silver available. These will contain more than twice the silver of our standard ingot. Each will be struck in high bas-relief with a satiny image and antique finish to clearly show every detail of the great art.

Your Valuable Personal Serial Number

Your First Edition Collection will be minted expressly for you and each ingot will be inscribed with your personal matching serial number along with The Hamilton Mint Hallmark. In addition, you will receive a certificate of authenticity to certify the limited edition status and precious metal content of each ingot.

Significant Investment Potential

We feel that many limited edition silver mintings are good investments but none do we feel has the potential of this particular Rockwell collection. And this comes at a time when leading economists are predicting that silver and gold will continue to become more valuable in the years ahead. Collectors have already realized bonanzas. So please act promptly to share in the excitement of owning this magnificent collection.

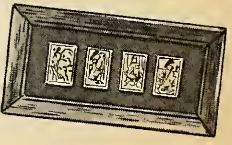
Deluxe Edition of 24 KT. Gold on .999 Fine Silver. This is the ultimate in beauty and combines the Pure Silver ingots with a layer of 24 KT. Gold. Each ingot will also be individually hallmarked and serially numbered.

Guaranteed Price Protection

Subscribers to The Four Freedoms are guaranteed the original purchase price, no matter how high the price of silver may escalate. You will receive your first ingot soon after your application is accepted and the three additional ingots at monthly intervals thereafter. The Hamilton Mint will not accept any orders postmarked after November 30, 1974, any orders received after that will regretfully be returned.

Special Display Frame At No Additional Cost

As a subscriber, you will receive, at no additional cost, an easel-backed display case of finely stained wood with a fine walnut finish.



OFFICIAL APPLICATION FORM

NORMAN ROCKWELL'S FOUR FREEDOMS

Valid only if postmarked by November 30, 1974

Mail to: **The Hamilton Mint**
40 E. University Drive, Arlington Heights, Ill. 60004

Please accept my application for a first edition proof set of Norman Rockwell's Four Freedoms. I understand I will receive my first ingot soon after my application is accepted. Enclosed is check or m.o. for $ ________________.

An Opportunity to Buy Silver Series & Save

☐ Send me first ingot in .999 fine silver @ $22.95 plus 75¢ for post & insur. (Remaining 3 ingots to be same price).

☐ Send me first ingot in 24 KT. gold on silver @ $27.95 plus 75¢ for post & insur. (Remaining 3 ingots to be same price).

Individual ingot (not serially numbered) may be purchased for $24.95 in silver and $29.95 in gold on silver. Add 75¢ each for postage and insurance.

Name ________________

Address ________________

City ________________

State ________________ Zip ________

Signature ________________
(must be signed to be valid)

I choose to charge my order to:
☐ Master Charge* ☐ Bank Americard

Account # ________________ Exp. Date ________

*If using Master Charge, indicate the four numbers above your name ________

NH 11-74

LIMIT: ONE PROOF SET PER SUBSCRIBER
Application subject to acceptance by The Hamilton Mint.

(Illinois residents please add 5% sales tax)

© Hamilton Mint 1974

Goose Down Bootees for Frigid Tootsies

For Men
and Women

For instant old-fashioned fireplace warmth, just ease those chilly feet into the luxurious softness of Bauer Goose Down quilted in long-wearing Expedition Nylon. Soft leather sole. Insulating foam insole. Specify shoe size and we will send a perfect fit. **Colors: 0146** Men's Taupe, Red, Navy; **0149** Women's Powder Blue, Red, Navy. Bootees, **$16.95 postpaid.**

Order Today! Money Back Guarantee!
Enclosed is my check or money order for
$________. (Add sales tax where applicable.)
Please RUSH my Goose Down Bootees.
Men's **0146** Size________Color________
Women's **0149** Size________Color________
Name________
Address________
City________
State________Zip________
☐ Send me FREE your color catalog of over 1200 exciting outdoor products.

Eddie Bauer

Dept. PNH, 1737 Airport Way S., Seattle, Wa. 98134

the finest, strongest, lightweight, aluminum camera equipment cases in the world!

ZERO HALLIBURTON
ALUMINUM CAMERA CASES

Made by the people who created the post-recovery Apollo moon rock containers — these world-famous aluminum cases provide life-time protection for your valuable equipment. See these prestigious, ultra-rugged cases at your photo dealer or write for literature.

BERKEY MARKETING COMPANIES, INC.
P.O. Box 1060, Woodside, N. Y. 11377
In Canada: Berkey Photo (Canada) Ltd., Ontario

Division of Berkey Photo Inc.

readily accepted. Maize and other cultivated plants also became available, but these could not be so easily adapted.

Both Samuel de Champlain and John Smith reported in the early seventeenth century that horticulture was largely limited to southern New England. The system of hunting, fishing, and gathering that they observed in Maine had persisted for centuries with only the slowest evolutionary changes over time. Maize would grow in Maine, however, but curiously, it was not seized upon as a food supplement. Once again, the answers lie in the details of the larger system.

Maize might have provided a hedge against starvation in the leanest months of the year. But the planting and harvesting required an investment of time and effort that could otherwise be spent on traditional subsistence techniques—hunting, fishing, and gathering. There would have been a handsome payoff in the years when conditions were good for maize, beans, or squash, but catastrophe when the harvest was bad.

Maine is a marginal area for maize. The Indians of a thousand years ago were keenly aware of the probable consequences of a single disastrous month in the middle of winter, and they would have foreseen the same potential consequences of a year or two of crop failure. What was needed was an additional hedge, something to act as insurance in times of poor maize production.

By 1560, beaver fur hats were becoming the rage in Europe, and European beaver colonies were quickly depleted. By the end of the century attention turned to the fur supply in the New World. In 1604, Champlain found that the Maine Indians were already aware of the benefits of the fur trade and were anxious to expand it. A brisk trade began: Jesuit missionaries arrived with the French traders, English settlers began to appear, and a series of changes and reactions to changes began to occur in the Indian cultural system.

Trade relations with the French encouraged the Indians to spend as much time as possible in their settlements near the coast. The Jesuits encouraged them to do so in order to convert them. The trend was in the direction of a social system more adapted to maize horticulture than it had been previously. At this point, English competition for the Indian fur trade was becoming increasingly important. Throughout the seventeenth century, the English colonists in southern New England had access to agricultural surplus, which they could trade for beaver pelts. It was the hedge against crop failure the Maine Indians needed.

The Indians' fortunes came to be linked to the commercial interests of the colonial French and English. The Indians were in close contact with the French, who urged them into permanent settlements. The English, who wished to cut into the French trade with the Indians, offered them maize and other valuable goods. It might have been a fatal arrangement, but the Indians learned to balance one colonial power against the other and in that way managed to survive the series of colonial wars that decimated so many other native Americans.

They were not so fortunate in avoiding the ravages of unfamiliar European diseases. The epidemics that preceded the colonial wars wiped out more than half the population. By 1620, dozens of villages were deserted—a population shift that accelerated the evolution of the cultural system. Some of the survivors of this and the colonial wars that followed moved to the Saint Lawrence River. Others remained in small communities in Maine.

The framework of human prehistory in Maine is by no means complete. But modern archeology has formulated the concepts necessary to rediscover the past. The concepts are a far cry from the simple chronologies and vague generalizations that once passed for explanation. By viewing culture as a system and the environment as a larger system to which it must adapt, archeologists can gain some insight into prehistoric ecology. The Archaic Indians were well adjusted to their environment, but when that environment changed, their culture had to evolve with it. Contact between late prehistoric Indians and Europeans led to a vast broadening of the aboriginal economic system and its eventual integration with that of Europe and Colonial America. Only after 1600 were the Maine Indians able to break free of the ecological restraints of their physical environment. □

You can help save Serita Rimini for $15 a month. Or you can turn the page.

The Rimini family
lives in a small stone house
nestled among olive trees and vineyards.
But this idyllic scene belies their tragic story.
Serita's father is dead.
Her mother, blind from glaucoma.
Serita wants to remain in school.
But she will have to leave to help support her family.
And she is only eight years old.

You can give a child like Serita that education so that she can grow up to live, not just exist. For $15 a month, through Save the Children Federation you can sponsor a child in many countries around the world and here at home. And a portion of your $15, combined with money from other sponsors, can help all the people in her community. With a desperately needed new school, child-care services, and vocational training. In simple terms, help a proud, hardworking people help themselves. This is what Save the Children has been all about since 1932.

For you—educated, involved, and in touch with your own heart—there are many rewards. Correspond with a child. Receive a photo and progress reports. Reach out to another human being. That's how Save the Children works. But without you it can't work. So please: clip this coupon and mail it today. Now you can turn the page.

Save the Children Federation is indeed proud of the handling of its funds. An annual report and audit statement are available upon request. Registered with the U.S. State Department Advisory Committee on Voluntary Foreign Aid. Contributions are income tax deductible.

I wish to contribute $15 a month to sponsor a ☐ boy ☐ girl:

☐ **Where the need is most urgent**
☐ Appalachia (U.S.)
☐ Bangladesh
☐ Chicano (U.S.)
☐ Colombia
☐ Dominican Republic
☐ Greece
☐ Honduras
☐ Indian (U.S.)
☐ Inner Cities (U.S.)
☐ Israel
☐ Korea
☐ Lebanon
☐ Mexico
☐ Southern Black (U.S.)
☐ Tanzania
☐ Vietnam

Enclosed is my first payment:
☐ $180 annually
☐ $90 semi-annually
☐ $45 quarterly
☐ $15 monthly
☐ Instead, enclosed is my contribution of $__________
☐ Please send me more information.

NAME____________________ TEL. NO.__________

ADDRESS______________________________

CITY____________ STATE__________ ZIP______

David L. Guyer, Executive Director

SAVE THE CHILDREN FEDERATION
345 East 46th Street, New York, N.Y. 10017

NH 11/4

Loss of the Tijger

In addition to his efforts to find the historic ship *Tijger*, the late James A. Kelly had a strong interest in Brooklyn history. He became assistant county clerk of Kings County (Brooklyn) and was in contact with property deeds and other historic documents. Eventually he was named borough historian and given a small office in Brooklyn's Borough Hall. The position was an honorary one and unpaid. However, he accumulated a large amount of historical material and made numerous talks before various Brooklyn organizations.

When he retired from the county clerk's office he became affiliated with St. Francis College in Brooklyn, where he helped create a Brooklyn historical department, which bears his name. For years, "Jamie Kelly," as he was familiarly known, was involved in every Brooklyn historical activity or celebration.

Joseph B. Milgram
Society of Old Brooklynites
Brooklyn, New York

The permanent loss of Adriaen Block's ship *Tijger* and its unknown companion was a horrible and unforgivable sin committed against the people of the city of New York. They have a right not to be continuously deprived of the cultural and historical treasures of their past ["Disappearance of the Historic Ship *Tijger*," August-September, 1974].

Christopher L. Hallowell made it clear that those doing the actual construction can only shoulder a small part of the blame. Indeed, if it weren't for people like James Kelly and Henry Druding, who took an interest in what they had uncovered, nothing at all would have been saved.

Mr. Hallowell's suggestion that the city hire an archeologist to keep an eye on excavation sites of historic value is probably the best solution to a continuing problem. But mindful of the city's past record in this area, it is very unlikely. Meanwhile, I mourn the loss.

James Touza
New York, New York

Let It Alone

In regard to "Driftwood Fantasy" by Robert Sommer [August-September, 1974], people will no doubt continue to ruin good driftwood with shoddy-looking flippers and obnoxious faces, but *must* you encourage them?

If you want sculpture, sculpt, but if you want driftwood, in the name of wind, water, and sand, *let it alone!*

Helen Bauer
Palo Alto, California

What Does It Mean?

Although still maintaining a passionate, druidical relationship with a shapely young pin oak outside my bedroom window, I am not entirely deaf to the logical blandishments of science.

When Gerald S. Hawkins starts to measure at, from, or about the likes of Stonehenge or the pyramids ["Celestial Clues to Egyptian Riddles," April, 1974], I take in every inch and cubit, foot and mile, declination and angle. At least I did.

When Hawkins writes about the bedrock base of the Great Pyramid chiseled level to a fraction of an inch and then adds, "the area of the base is thirteen acres, or seven average-sized city blocks," he demolishes my faith in any number of exact sciences.

I realize things tend to get smaller and more crowded as you move east from Kansas City to Cambridge, and apparently even more so as you move on to Egypt. At any rate, the last average-sized city block I lived on was ten acres.

For many summers I mowed half of this, running all the way from 65th to 64th Street, unquestionably one block, and in the process became the Midwest's leading authority on exactly how large an area five acres is.

I have therefore determined to make all of my own measurements in the future . . . beginning this morning. I now live in an apartment complex overlooking mile 367 where the Missouri River runs through Kansas City.

I arose before sunrise of the summer solstice and in consultation with my pin oak decided it felt like about 84 degrees 40 minutes west longitude by 38 degrees 9 minutes north latitude at an altitude of a little more than 700 feet above sea level.

My apartment door opens on a courtyard that faces east, southeast, I like to think, because that is where the sun rises. The door has one of those little fisheye peepholes that lets you see who is there without opening it, and the first rays of the rising sun on June 21 are focused in a golden spot directly in the center of the hall closet.

What does it all mean?

Jim Lapham
Riverside, Missouri

English System's Last Mile (1.609 km)

The publishing world should take the lead in starting this country on the road to the metric system. Eventually, the United States will change to the metric system, as have all other major countries.

I strongly urge you to adopt a system of dual measurements when printing numerical data—use both the English and the metric systems, such as: I weigh 160 pounds (72.7 kg). This would allow people to become accustomed to the metric system, and resistance to such a change would be greatly reduced.

Richard Bronson
Jonesboro, Georgia

A Bouquet

Stephen Jay Gould's column "On Heroes and Fools in Science" [August-September, 1974] was refreshing and jogged my preconceptions (something I think should happen to everyone periodically). Your magazine helps me avoid becoming a narrow specialist.

Lt. Comdr. R. S. Peterson
Arlington, Virginia

Lou Byrne, women's world personality, talks about her very special personal retreat.

"Everyone says the same thing when they come to the Cayman Islands— 'I just love it.'"

"From my home at Mitchell's Creek Gardens the pressures of work seem so far away, yet I'm only one hour by jet from Miami."

"I'm helping my Cayman friends build a new college . . . fantastic things are happening here!"

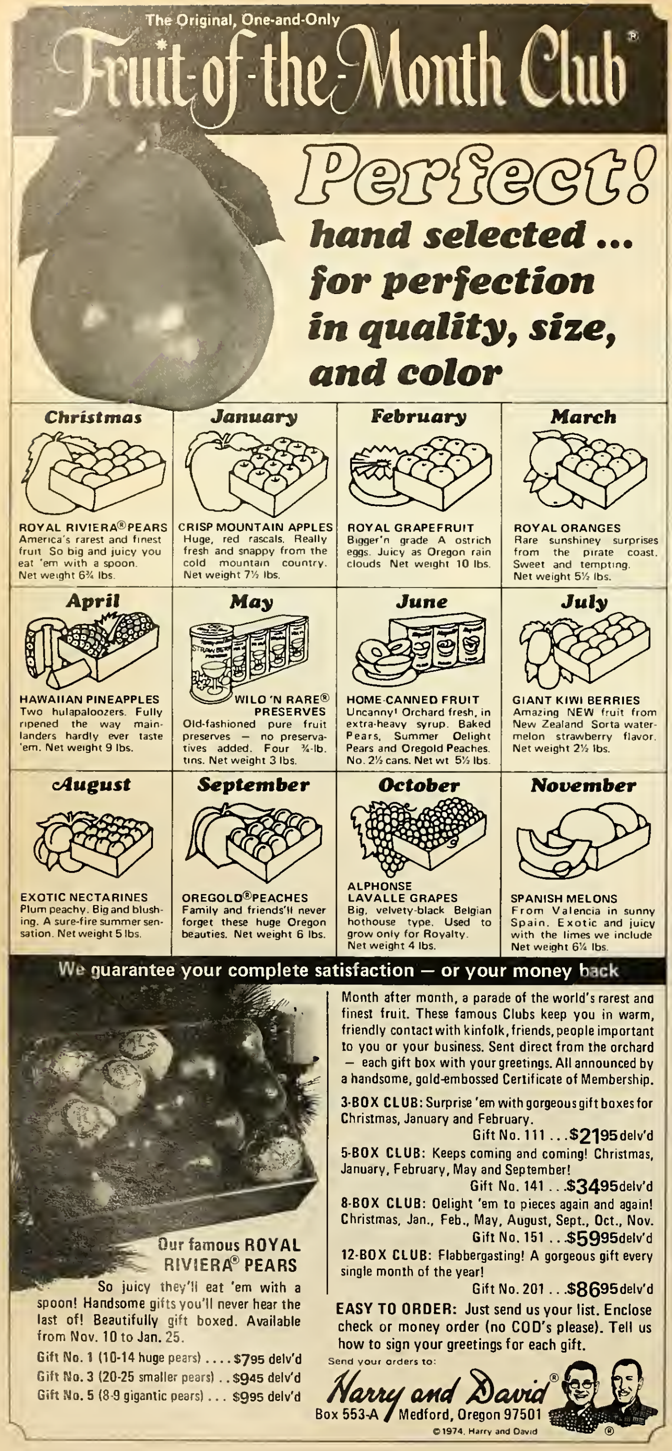
Lou Byrne, TV personality and devoted fund raiser for New York's American Museum of Natural History, finds that, "Really relaxing is as important and necessary to me as my work. My home at Mitchell's Creek Gardens has everything I need to enjoy life—tennis courts, swimming pool, a wonderful park, saunas . . . everything! And I love to entertain here. It's so elegant and so comfortable, my friends never want to leave. Neither do I!"

Because Cayman is a tax haven, Lou Byrne pays no real estate taxes on her home here, which makes life just that much nicer. It all adds up to make Mitchell's Creek Gardens a very special personal retreat. It could be yours.

Write on your personal stationery for detailed information.

Mitchell's Creek Gardens Ltd.* Dept. B-251
Interbank House
Grand Cayman, British West Indies.

*A member of the Interbank House group of companies, Grand Cayman, British West Indies.


The Original, One-and-Only
Fruit-of-the-Month Club®

Perfect!
hand selected ...
for perfection
in quality, size,
and color

Christmas	January	February	March
ROYAL RIVIERA® PEARS America's rarest and finest fruit. So big and juicy you eat 'em with a spoon. Net weight 6¾ lbs.	CRISP MOUNTAIN APPLES Huge, red rascals. Really fresh and snappy from the cold mountain country. Net weight 7½ lbs.	ROYAL GRAPEFRUIT Bigger'n grade A ostrich eggs. Juicy as Oregon rain clouds. Net weight 10 lbs.	ROYAL ORANGES Rare sunshiney surprises from the pirate coast. Sweet and tempting. Net weight 5½ lbs.
April	**May**	**June**	**July**
HAWAIIAN PINEAPPLES Two hulapaloozers. Fully ripened the way mainlanders hardly ever taste 'em. Net weight 9 lbs.	WILO 'N RARE® PRESERVES Old-fashioned pure fruit preserves — no preservatives added. Four ¾-lb. tins. Net weight 3 lbs.	HOME-CANNED FRUIT Uncanny! Orchard fresh, in extra-heavy syrup. Baked Pears, Summer Delight Pears and Oregold Peaches. No. 2½ cans. Net wt 5½ lbs.	GIANT KIWI BERRIES Amazing NEW fruit from New Zealand. Sorta watermelon strawberry flavor. Net weight 2½ lbs.
August	**September**	**October**	**November**
EXOTIC NECTARINES Plum peachy. Big and blushing. A sure-fire summer sensation. Net weight 5 lbs.	OREGOLD® PEACHES Family and friends'll never forget these huge Oregon beauties. Net weight 6 lbs.	ALPHONSE LAVALLE GRAPES Big, velvety-black Belgian hothouse type. Used to grow only for Royalty. Net weight 4 lbs.	SPANISH MELONS From Valencia in sunny Spain. Exotic and juicy with the limes we include. Net weight 6¼ lbs.

We guarantee your complete satisfaction — or your money back

Our famous ROYAL RIVIERA® PEARS

So juicy they'll eat 'em with a spoon! Handsome gifts you'll never hear the last of! Beautifully gift boxed. Available from Nov. 10 to Jan. 25.

Gift No. 1 (10-14 huge pears)	$7.95 delv'd
Gift No. 3 (20-25 smaller pears)	$9.45 delv'd
Gift No. 5 (8-9 gigantic pears)	$9.95 delv'd

Month after month, a parade of the world's rarest and finest fruit. These famous Clubs keep you in warm, friendly contact with kinfolk, friends, people important to you or your business. Sent direct from the orchard — each gift box with your greetings. All announced by a handsome, gold-embossed Certificate of Membership.

3-BOX CLUB: Surprise 'em with gorgeous gift boxes for Christmas, January and February.
Gift No. 111 . . . $21.95 delv'd

5-BOX CLUB: Keeps coming and coming! Christmas, January, February, May and September!
Gift No. 141 . . . $34.95 delv'd

8-BOX CLUB: Delight 'em to pieces again and again! Christmas, Jan., Feb., May, August, Sept., Oct., Nov.
Gift No. 151 . . . $59.95 delv'd

12-BOX CLUB: Flabbergasting! A gorgeous gift every single month of the year!
Gift No. 201 . . . $86.95 delv'd

EASY TO ORDER: Just send us your list. Enclose check or money order (no COD's please). Tell us how to sign your greetings for each gift.

Send your orders to:
Harry and David®
Box 553-A / Medford, Oregon 97501
©1974, Harry and David

Photography Want List

The Want Lists published last winter produced several striking photographs for *Natural History* magazine. In hopes of obtaining more beautiful and interesting illustrations, we are again listing subjects under consideration for future issues. Readers are invited to submit up to ten high-quality photographs. Pictures that are used will be paid for at the magazine's usual professional rates. Photographs should be sharp, properly exposed color transparencies, 35 mm or larger. Those that are not suitable will be returned promptly.

Each item submitted should have the name and address of the sender on it. Mail transparencies to:

Photograph Editor
Natural History Magazine
Central Park West at 79th Street
New York, New York 10024

Flora: Oaxaca Valley, particularly scenes showing irrigation devices and farmers irrigating fields. Rain forests of Western Samoa, especially lumbering operations. Pictures showing impact of human use on wilderness areas.

Fauna: Wolves and deer interacting, coyotes, grizzly bears, harpy seals, dingoes, kangaroos, parma wallabies. potoroos, penguins—particularly of penguin rookeries—spotted owls, platypuses, dragonflies, horseshoe crabs, army ants.

Disasters: Tornadoes. Avalanches and avalanche damage in Swiss villages.

Miscellany: West African fabrics. Women in developing countries nursing or, especially, bottle feeding their infants.

Notice: The sending of film to us will constitute an agreement by you that if any such film is damaged or lost by us it will be replaced with an equivalent amount of unexposed film. Except for such replacement, the handling of such film by us is without liability.

The place: on top of the world.
The mood: elegant.
The drink: Kahlúa® Black Russian.

KAHLÚA
IMPORTED
FROM SUNNY MEXICO
KAHLÚA
HECHO EN MEXICO
LICOR DE CAFÉ
COFFEE LIQUEUR 53 PROOF
PRODUCT OF MEXICO 26½ GL
CARAMEL COLOR ADDED
HECHO POR
KAHLUA, S. A.
FABRICA DE LICOR DE CAFE
MARCA REGISTRADA
PREPARED AND BOTTLED IN THE U.S.A.
& ASSOCIATES, INC., LOS ANGELES, CALIF.

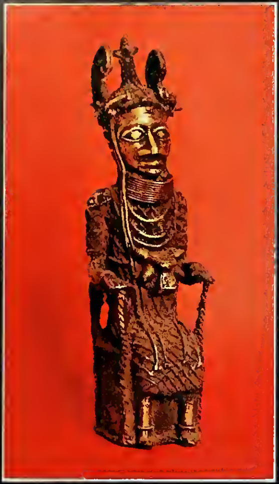
This is the one—anytime good taste is in order. Mix one ounce of Kahlúa and two ounces of vodka on the rocks. Now just relax . . . and enjoy.

Do send for our Kahlúa recipe book. Compliments of the house. Because you deserve something nice.

Kahlúa. 53 Proof. Coffee Liqueur from Sunny Mexico. Maidstone Importers, 116 No. Robertson Blvd., Los Angeles, Calif. 90048.

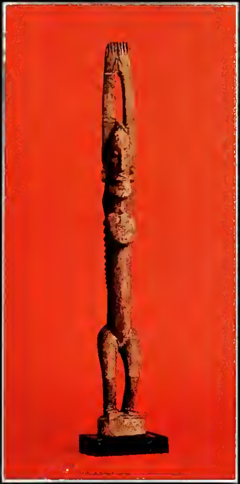
BENIN CITY, bronze [Nigeria]

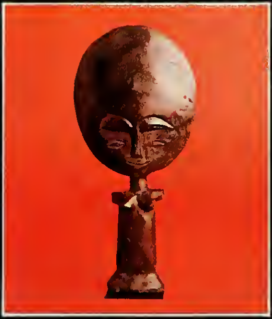
Cast by the lost wax process for the royal families, this figure of the Oba (King) of Benin links the contemporary tribe with the great kingdom of the 17th, 18th and 19th centuries. Bronze, hgt. approx. 19″. $700.



DOGON, figure [Mali]

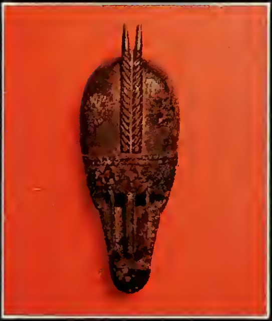
According to the Dogon myth, the Tellem were their ancestors. This Tellem figure is often used to protect the grain. This style is always severely geometric, a characteristic of Mali art. Wood, hgt. approx. 26″. $45 incl. mount.





ASHANTI, doll [Ghana]

Young women wear these dolls, which are said to embody the Ashanti ideal of beauty, in order that their child, too, will be beautiful. The disc-shape head, simplified features and geometric body are traditional. Wood, hgt. approx. 11″. $25 incl. mount.



MARKA, mask [Mali]

The Marka, a sub-tribe of the Bambara, use fire and metal to give this mask special powers. The pure geometry and abstract quality are typical of the strong style of the Western Sudanese. Wood and metal, hgt. 16″. $90.

The noble tribes of Africa offer

Thousands of Africans in the drought-stricken Sahelian zone are dying from starvation, malnutrition and disease. When you purchase even a single piece of African art, you help hundreds to survive — including, perhaps, the artist himself. You may also be making a very interesting investment.

Unlike the art of many ancient cultures, the strength and vitality of African art remains undiminished even after 8000 years. The tools and methods used centuries ago are the same ones used today: the object is fashioned by an iron-bladed adz from the soft wood of a young tree; a knife is used to carve the fine details; the surface is smoothed by sand rubbed with leaves; and, a patina is developed with oil and smoke, or simply through frequent handling in ceremonies.

Long before Europeans "discovered" Black Africa — the region south of the Sahara — tribal kingdoms flourished as a close-knit network of villages. The inhabitants were farmers of the rainforests and adjacent savannahs, and as their fundamentally religious art evolved, it fulfilled functional, earthly needs. Rain, fertility, power, good fortune — all of the elements necessary to the survival of these societies — became embodied in their art forms.

Sculptors worked entirely within the unique traditions of their tribal styles and design motifs and were generally anonymous. Thus, the highly functional art of Black Africa has a remarkable consistency. But while the tools, materials and methods are unchanged, fewer and fewer villages are producing their traditional art. After 8000 years the flame is flickering.

The Killing Drought

Six years ago, the vast Sahara began creeping southward. Mile by mile it overwhelmed the fragile viability of the Sahel — the broad, arid savannah that runs from the Atlantic to the Red Sea — and choked its watering holes with dust. Each year the drought has become more devastating, its impact more irreversible. Cattle have perished by the millions. Children and new mothers — always the chief victims of famine — are dying of starvation, disease, and malnutrition. Hundreds of thousands of Sahelians from Chad, Niger, Nigeria, Mauritania, Upper Volta, Mali, Senegal, as well as Ethiopians, have fled before the oncoming Sahara to already overcrowded cities and refugee centers.

Among the organizations that have responded to pleas for help is CARE, a non-profit, nonsectarian, private agency for voluntary international aid and development. In its 29 years of existence, CARE has responded to the needs of people in 77 countries on four continents by providing them with $1.5 billion worth of aid.

The Urgent Challenge

"Half of all the world's people suffer chronic hunger or serious dietary deficiency.

"The world has many millions of persons to feed every day to keep them from starvation. But the real need — the urgent challenge — is to increase their ability to help themselves.

"We welcome the Tribal Arts Society program. It helps Africans help themselves by providing a market for their art. It also provides CARE with critically needed funds for direct Sahelian relief and rehabilitation."

— Harold S. Miner,
President, CARE

KURUMBA, figure [Upper Volta]

This antelope god, related to agriculture, is one of the few sculptural forms of the Kurumbas. The polychromed, geometric patterns also appear on the masks of the neighboring Bobo tribe. Wood, hgt. approx. 30″. $65 incl. mount.

BAMBARA, headdresses [Mali]

Legend has it that Chi Wara, antelope god of the Bambara, taught man to till the soil. The single male figure and the female with baby are paired in dances related to agriculture. The openwork technique was admired by Picasso and Modigliani. Wood and raffia, hgt. approx. 37″ [male], 35″ [female]. $100 each incl. mount.

SENUFO, Mask [Ivory Coast]

Dance mask (kpelie) used by male initiates during their bush ceremonies. Various tribal castes, as well as wings and legs, are symbolized. This mask also serves to drive away "soul eaters" or sorcerers. Wood, hgt. approx. 20″. $40.

MOSSI, mask [Upper Volta]

This mask is carved from a single piece of wood to retain the female spirit it embodies. It is danced by the Wango society in funeral ceremonies and rites of harvest. Wood, hgt. approx. 54″. $180.

you their art–to survive.

Relief and Rehabilitation

CARE is now providing all the food and medical supplies it can to starving Sahelians in Chad, Niger, and Nigeria. It is also aiding water development projects. But CARE's resources alone cannot possibly cope with the problem. The threat of famine hangs over millions of Africans as calls for help increase. Emergency relief must continue — but, all possible priority must be given to rehabilitation aid.

You can help.

The noble tribes of Africa are offering you their art to help the Sahelians survive. Depending on the piece selected, as much as 30% but not less than 10% of the regular retail price of each object sold will go directly into CARE programs in the Sahel. CARE is rated the most efficient agency of its kind in America. Even your smallest purchase will buy a nutritious meal for 216 children. $2500 builds a safe water system for 1,000 villagers.

An Investment in Life and Art

CARE will acknowledge in writing the exact contribution it received as a result of your purchase and send you a report on how this money was spent. It will make you proud to know that the art you cherish and the donation you made possible helped save lives — including, possibly, the artist's.

Your purchase also insures your election to charter membership in the Tribal Arts Society, a new organization devoted to the support and appreciation of authentic native arts. Through its direct and often exclusive arrangements with tribes the world over, the Tribal Arts Society is able to offer you prime examples of the work of master artists and craftsmen. You will have many opportunities to purchase these offerings but never any obligation.

The Prospects of Appreciation

While you may be moved to acquire one of these selected examples of tribal art for aesthetic or charitable reasons — or both — you will also be interested to know that prices for authentic African art have tripled in just the past five years. And last July, a rare antique Benin bronze figure from Nigeria brought $442,150 at Sotheby's — the highest price ever paid for a piece of "primitive" art.

TRIBAL ARTS SOCIETY, GALLERY 1
84 East 10th Street
New York, N.Y. 10003

Gentlemen: Please send me the African tribal art I have selected, accompanied by your signed certificate of authenticity. You will pay CARE between 10% and 30% of the purchase price, which will be acknowledged to me in writing by CARE, and this money will go directly into CARE programs in the African drought zone.

I will also be elected to Charter Membership in the Tribal Arts Society and receive all benefits and privileges of membership without any further cost or obligation.

I reserve the right to return my purchase within 30 days for full refund and cancel my membership if I am not satisfied.

☐ Bambara headdress — male $100
☐ Bambara headdress — female $100

☐ Mossi mask $180
☐ Senufo mask $40
☐ Dogon figure $45
☐ Benin City Bronze $700

☐ Kurumba figure $65
☐ Ashanti doll $25
☐ Marka mask $90

Add 5% postage and handling charges
N.Y. residents add sales tax. TOTAL $__________
Enclosed is ☐ check ☐ money order. Please charge ☐ Diners Club ☐ American Express ☐ Bank Americard ☐ Master Charge

Master Charge Interbank # ________________

Account # ________________ Expires________

Signature________________________

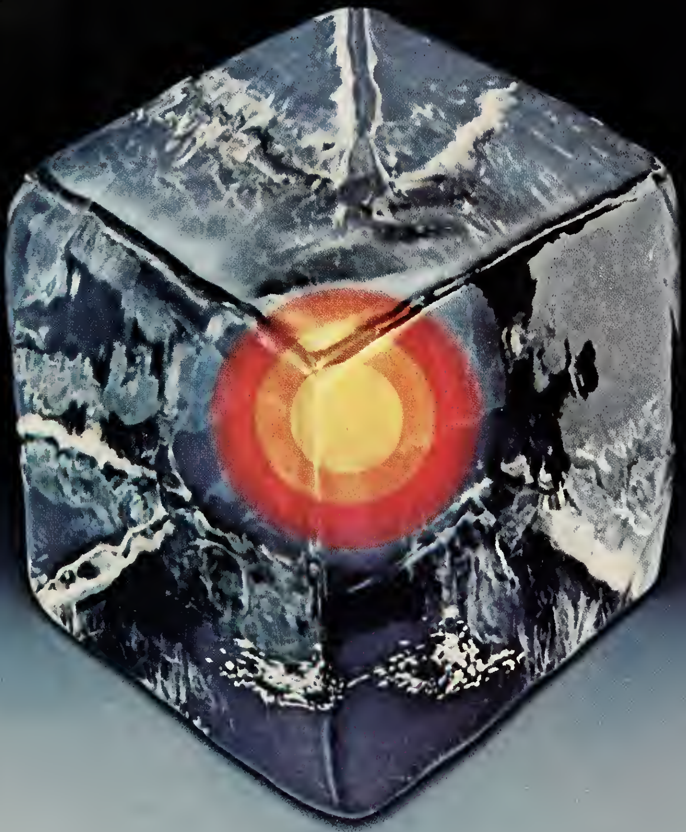
Name________________________

Address________________________

City__________ State_______ Zip_______

The ideal

To tap Alaska's vast reserves
of vitally needed energy resources
while preserving its unique environment.



The real

To tap Alaska's vast reserves
of vitally needed energy resources
while preserving its unique environment.

AtlanticRichfieldCompany

An Unsung Single-celled Hero

A small unknown cropper of the early Cambrian period probably set life on its diverse and glorious course

Ernst Haeckel, the great popularizer of evolutionary theory in Germany, loved to coin words. The vast majority of his creations died with him a half-century ago, but among the survivors are "ontogeny," "phylogeny," and "ecology." The last is now facing an opposite fate—loss of meaning by extension and vastly inflated currency. Common usage now threatens to make "ecology" a label for anything good that happens far from cities or anything that does not have synthetic chemicals in it. In its more restricted and technical sense, ecology is the study of organic diversity. It focuses on the interactions of plants, animals, and their environments in order to address what may be the most fundamental question in evolutionary biology: "Why are there so many kinds of animals?" (as Yale ecologist G. Evelyn Hutchinson inquired in the subtitle of his most famous article).

During the first century of Darwinism, ecologists pursued this question with little success. In the face of life's overwhelming complexity, they chose the empirical route and amassed storehouses of data on simple systems in limited areas. Now, fifteen years after the centennial of Darwin's *Origin of Species*, this poor sister among evolutionary disciplines has become the leader. Spurred by the efforts of scientists with a mathematical bent, ecologists have built theoretical models of organic interaction and applied them successfully to explain data from the field. We are finally beginning to understand (and quantify) the causes of organic diversity.

An important scientific advance usually extends its influence by providing keys to the resolution of persistent problems in related fields. Theoretical ecology, which works in the smallest dimension of "ecological" time (organic interactions over seasons or, at most, years), has begun to influence paleontology, the custodian of the longest dimension of all—three billion years of the history of life.

Last month, I discussed how an ecological theory relating organic diversity to habitable area may have solved the great mystery of the Permian extinction. This month, I will argue that another ecological theory, the relationship of diversity to predation, may provide the major clue in solving the second greatest dilemma of paleontology: the Cambrian "explosion" of life.

About 600 million years ago, at the beginning of what geologists call the Cambrian period, most of the major phyla of invertebrate animals made their appearance within the short span of a few million years. What had happened during the previous four billion years of earth history? What was it about the early Cambrian world that could have inspired such a burst of evolutionary activity?

These questions have disturbed paleontologists ever since the evolutionary view triumphed more than a century ago. For although rapid bursts of evolution and massive waves of extinction are not inconsistent with Darwinian theory, a deeply rooted bias of Western thought predisposes us to look for continuity and gradual change: *na-*

Was Nero a Good Emperor?

Did the Etruscans come from Troy?—Was Stonehenge built by Minoans?—Did early Greek meet Neanderthal?—What's the truth about Von Daniken's "astronaut gods?"—Did Vikings settle in North America? If questions like these intrigue you, read (and give)

ART AND ARCHAEOLOGY NEWSLETTER,

filled with little-known facts about the ancient world, new finds and deductions, photos, highlights on manners and mores, travel tips, more. Now in its 9th year. Library Journal says: "authoritative . . . packed with fascinating information." Send $7.50 for 8-issue subscription (2 yrs.) to **O. N. REISS CO., 243 East 39th Street, New York, N.Y. 10016.**

Special—ANCIENT COINS:

1 Greek coin, over 2000 years old, and 1 Roman coin with portrait of early Emperor, plus 4-issue subscription, only $25.00. (N.Y. res. add sales tax.) Handsome coins are guaranteed genuine, come in hinged cases with indiv. histories. Make perfect gifts! Money back in 10 days. Send check or M.O. to above address.

I.Q. of 145 and Can't Remember?

A noted publisher in Chicago reports there is a simple technique for acquiring a powerful memory which can pay you real dividends in both business and social advancement and works like magic to give you added poise, necessary self-confidence and greater popularity.

According to this publisher, many people do not realize how much they could influence others simply by remembering accurately everything they see, hear, or read. Whether in business, at social functions or even in casual conversations with new acquaintances, there are ways in which you can dominate each situation by your ability to remember.

To acquaint the readers of this publication with the easy-to-follow rules for developing skill in remembering anything you choose to remember, the publishers have printed full details of their self-training method in a new booklet, "Adventures in Memory," which will be mailed free to anyone who requests it. No obligation. Send your name, address, and zip code to: Memory Studies, 555 E. Lange St., Dept. 804-81, Mundelein, Ill. 60060. A postcard will do.

tura non facit saltum ("nature does not make leaps"), as the older naturalists proclaimed.

The Cambrian explosion so disturbed Charles Darwin that he wrote in the last edition of his *Origin of Species:* "The case at present must remain inexplicable; and may be truly urged as a valid argument against the views here entertained." The situation was, indeed, far worse in Darwin's day. At that time, not a single Precambrian fossil had been found, and the Cambrian explosion of complex invertebrates provided the earliest evidence for any life on earth. If so many forms of life arose at the same time and with such initial complexity, might one not argue that God had chosen the base of the Cambrian for His moment (or six days) of creation?

Darwin's difficulty has been partly circumvented. We now have records of Precambrian life stretching back more than three billion years. Fossil bacteria and blue-green algae have been recovered in several places from rocks dated at between two and three billion years in age.

In the procrustean system that forces us to call every organism either a plant or an animal, bacteria and blue-green algae have been ranked among the plants. But this classical taxonomy is now in disarray, for the most fundamental taxonomic distinction may well be between bacteria and blue-green algae on the one hand and all "higher" forms on the other. Bacteria and blue-green algae have no organelles in their cells: no nucleus, no mitochondria, no chromosomes. Sustained and orderly sexual reproduction required the evolution of organelles and the packaging of DNA into discrete units that could pair and separate to provide sex cells with exactly half the genetic information of a normal body cell. And most evolutionists argue that sex is a prerequisite for the evolution of complex organisms since it so strongly increases the variation that natural selection requires by mixing the DNA of two separate individuals into a single organism. (Sex and reproduction have distinctly different biological functions: enhancing variability in one case; propagation in the other. The two functions often are expediently combined to convey variability to offspring.)

Just possibly the most useable jacket you can own.

A 10 oz. reversible jacket that's made like a space suit to work like a thermos bottle!

When the guy who makes the Apollo Jacket first showed it to me, he said it would keep me warm in cold weather and comfortably cool when it was warm. I explained to him (using some fairly spicy words) that he should seriously consider committing himself before somebody else did. And it's a good thing I used those "spicy" words, because I ended up eating every one of them.

Four years of testing convinced me!

After 4 years of personal testing in places ranging from a Swiss ski resort to tropical Tenerife in the Canary Islands, I can honestly say that this is one of the most useable jackets available today. It's made from a fabric developed for use in space suits, and it really works.

Rolls up for easy pocking.

Here's how!

A tough aluminum skin is bonded to 100% nylon to give you a jacket that reverses to suit the weather and your comfort. Wear the navy side out when it's cold. It absorbs warmth from the sun and the silver side next to your body retains a large percentage of your natural heat. In warm weather, wear the silver side out. It reflects the sun's rays and helps keep you comfortably cool.

Tuck-away hood in collar.

Try it yourself for two weeks!

I know this is a tough one to believe, and that's only half of it. The Apollo is also *windproof*, practically *rainproof*, and can be rolled up for carrying in your back pocket. Try it yourself for two weeks. If you're not completely satisfied, return it to us, postage prepaid, for a full refund. No ifs, ands, or buts.

Color: Blue reversing to silver. **Sizes:** S, M, L, XL, XXL, to fit Men's 34-52; Women's 6-20. Send suit or dress size for proper fit.

$32.00 ppd.

With the navy side out, you'll be warm and protected from the cool sea breezes while yachting.

A sunny day on the ski slopes can get pretty warm. Wear the silver side out and stay comfortably cool.

Norm Thompson

Dept. NH-N
1805 N.W. Thurman
Portland, Or. 97209

Order TOLL FREE anytime 800-547-6712
(Excluding Oregon, Hawaii, and Alaska)

Name

Address

City

State Zip

Apollo Jkt.	Qty.	Size
Men's		
Women's		

☐ Check enclosed. Charge to my
☐ BankAmericard ☐ Master Charge.

(Please include all raised letters and numbers on credit card.)

Card #

Signature X

Escape from the ordinary

☐ **Send FREE 80 pg. color catalog**

Just off the press and loaded with new and exciting items, many of which simply can't be purchased anywhere else in the world. Save on exclusive fashions, sports equipment, and articles for your home.

The great step in the evolution of organelles seems to have occurred between one and two billion years ago. An outstanding flora recovered from Australian rocks about a billion years old contains abundant fossils of complex green algae, true plants with organelles.

Nonetheless, these exciting finds in Precambrian paleontology do not remove the problem of the Cambrian explosion, for they include only the simple forms without organelles and some higher plants such as green algae. The evolution of complex Metazoa (multicelled animals) seems as sudden as ever. (A single Precambrian fauna has been found at Ediacara in Australia. It includes some relatives of modern fan corals, jellyfish, wormlike creatures, arthropods, and two cryptic forms unlike anything alive today. Yet the Ediacara rocks lie just below the base of the Cambrian and qualify as Precambrian only by the slimmest margin. A few more isolated animal finds from other areas around the world are likewise just barely Precambrian.) If anything, the problem is increased because exhaustive study of more and more Precambrian rocks destroys the old and popular argument that complex Metazoa are really there, but we just haven't found them yet.

The last century of argument has produced only two basic strategies for a scientific explanation of the Cambrian explosion.

First, it is a false appearance. Evolution was really slow and gradual, as Western biases dictate. The so-called explosion only marks the first appearance in the fossil record of creatures that had been living and developing for a long part of the Precambrian. But what prevented the fossilization of such rich faunas? Here we have a variety of proposals ranging from the absurdly *ad hoc* to the eminently plausible. To cite just a few:

(1) The Cambrian represents the first preservation of unaltered rocks; Precambrian sediments have been subjected to such heat and pressure that their fossil remains have been obliterated. This proposal is empirically false.

(2) Life evolved in terrestrial lakes. The Cambrian represents the migration of this fauna to the sea. Precambrian lake deposits are unknown.

FLY THE AFRICAN EXPRESS.

It's New York to Dakar non-stop.
It's the greatest way to the last great continent.
It's Air Afrique. The African airline that knows Africa best.

Air Afrique's African Express jet adventures-off from Kennedy every Saturday at 6 P.M. Its destination: Dakar, and then on to Robertsfield/Monrovia, Abidjan, Lome, Douala, Libreville, and Kinshasa.

But Africa begins in the sky on Air Afrique. Our food is the finest African cuisine. Our stewardesses are dressed in magnificent native fabrics (one of Africa's finest arts). And our friendship is just a hint of what you'll find when you land.

Discover Africa. Our coupon can bring you closer. Our African Express can bring you there.

AIR AFRIQUE

Air France, General Agent. Box DC8
New York, N.Y. 10011
Please send me information about
Air Afrique's Africa immediately.

Name__________
Address__________
City__________State__________
Zip__________Phone__________
Travel agent__________
Or call any Air France office. RK-NH-11-74

Air Afrique's fleet now features DC-10's clean-powered by General Electric jet engines.

The Beach and Tennis Club at John's Island is an architectural gem— in a setting of great tropical beauty

The understated lines of classic design characterize everything built on John's Island. Here, in a world apart, is a privately owned resort community for a discerning, conservative clientele. We offer residential properties, golf cottages and oceanfront apartments for both purchase and rental. For our hard-cover book, illustrated with 99 color photographs and available at $5, write to Roy D. Chapin III, 314 John's Island Drive, Vero Beach, Florida 32960.

john's island

Obtain the HUD Property Report from developer and read it before signing anything. HUD neither approves the merits of the offering nor the value of the property as an investment, if any. This offering is not available to residents of states where prohibited by law. AD# 12088

Color 22"x28" edition, 5000 signed and serial numbered, $50

Fine Collector Prints

Write for a 5"x6" color miniature of this beautiful print, provided without cost in the interests of conservation, excellent for framing. Please include 25¢ for postage and handling.

"Pintail" by Richard Sloan

Greatest wild bird artist of the 20th Century for detail and authenticity.

Nature House, Box 398-Z
Griggsville, Illinois 62340

(Prices subject to change without notice)

(3) All early metazoans were soft-bodied. The Cambrian represents the evolution of fossilizable hard parts. The popularity of this strategy has plummeted with the discovery of abundant Precambrian fossil deposits devoid of anything more complex than algae.

The argument based on hard parts probably contains an element of truth, but it cannot be the entire answer. A clam without a shell is not a viable animal; you cannot clothe any simple soft-bodied form to make one. The delicate gills and the complex musculature clearly evolved in association with a hard outer covering. Hard parts often require a simultaneous and complex modification of any conceivable soft-bodied ancestor: their sudden appearance in the Cambrian, therefore, implies a truly rapid evolution of the animal they cover.

The second explanation for the Cambrian explosion is that it is a real event representing the extremely rapid evolution of complexity. Six hundred million years ago something must have happened to the environment of simple, soft-bodied precursors of Cambrian metazoans in order to engender such a rapid burst of evolution. We have only two nonexclusive possibilities: changes in the physical or in the biological environment.

In 1965, Lloyd V. Berkner and Lauriston C. Marshall, two physical scientists from Dallas, published a famous article proposing that levels of oxygen in the earth's atmosphere exerted a direct physical control on the Cambrian explosion of life. Geologists agree that the earth's original atmosphere contained no free oxygen. Oxygen built up gradually as a result of organic activity—the photosynthesis of Precambrian algae. Metazoans require high levels of free oxygen for two reasons: directly, for respiration; indirectly because oxygen in the form of ozone absorbs harmful ultraviolet radiation in the upper atmosphere before it reaches life on the earth's surface. Berkner and Marshall proposed that the amount of oxygen in the Cambrian reached a level sufficient for metazoan respiration and for absorption of harmful radiation.

But this attractive notion has foundered on the geologic evidence. Photosynthesizing organisms were probably abundant more than two and a half billion years ago. Is it

Take any 3 books for only 99¢ each

as a member of the

Natural Science Book Club

ISLAND AT THE CENTER OF THE WORLD
comets, meteorites & men
BEYOND STONEHENGE
ALD S. HAWKINS

FIRST CLASS
PERMIT NO. 102
RIVERSIDE, N.J.

BUSINESS REPLY MAIL
No postage stamp necessary if mailed in the United States

Postage will be paid by

Natural Science Book Club
Riverside, New Jersey 08075

MEMBERSHIP APPLICATION

Natural Science Book Club 4-93A

Riverside, New Jersey 08075

Please accept my application for membership and send me the three volumes indicated, billing me only 99¢ each. I agree to purchase at least three additional Selections or Alternates during the first year I am a member, under the plan described in this ad. Savings range up to 30% and occasionally even more. My membership is cancelable any time after I buy these three books. A shipping and handling charge is added to all shipments. **Send no money. Members are billed when books arrive.**

3 books for only 99¢ each

Indicate by number the 3 books you want.

☐ ☐ ☐

Some expensive books count as 2 selections.

Name ______________________

Address ______________________

City ______________ State ______________ Zip ______________

Book selections purchased for professional purposes may be a tax-deductible expense. (Offer good in Continental U.S. and Canada only. Prices slightly higher in Canada.)

NATURAL HISTORY MAGAZINE

HOW THE CLUB OPERATES

- You begin by choosing any three of these exciting books for just 99¢ each (a stunning value!).
- You keep on saving substantially on all the books you buy. Savings range up to 30% and occasionally even more.
- Your Book Club **News,** describing the coming Main Selection and Alternate Selections, will be sent to you 15 times a year at three to four week intervals.
- If you wish to purchase the Main Selection, do nothing and it will be shipped to you automatically.
- If you prefer one of the Alternates, or no book at all, simply indicate your decision on the reply form always enclosed with the **News** and mail it so we receive it by the date specified.
- The **News** is mailed in time to allow you at least 10 days to decide if you want the coming Main Selection. If, because of late mail delivery of the **News,** you should ever receive a Main Selection without having had the 10 day consideration period, that Selection may be returned at Club expense.
- After completing your trial membership, you will be entitled to take advantage of our fabulous bonus plan.

From our treasure house of books on the natural sciences, pick a few treasures for yourself. Or as gifts.

78820. THE SOCIAL BEHAVIOR OF THE BEES. *Charles D. Michener* One of the world's foremost authorities on bees offers the first definitive work on group phenomena among these most amazing insects. A publishing classic. *Counts as 2 of your 3 books* **$25.00**

84210. THIS LIVING REEF. *Douglas Faulkner.* An underwater photographer of unequaled skill and rare imagination offers a lavishly illustrated word-and-picture masterpiece on one of the South Pacific's most beautiful island chains. Outsized volume contains 120 pages of glorious six-color pictures. *Counts as 2 of your 3 books* **$25.00**

58620. THE LIFE GAME. *Nigel Calder.* Reporting on the dazzling research of the New Biology, the author of *The Violent Universe, The Mind of Man,* and *The Restless Earth* explores the ultimate biological question: Why do we exist? Provocative reading. **$12.50**

34560. ASTROPHYSICAL CONCEPTS. *Martin Harwit.* Challenging new presentation of an important new science, which bridges chemistry, physics, biology, mathematics, astronomy, meteorology and the earth sciences. **$14.95**

87230. WILD RIVERS OF NORTH AMERICA. *Michael Jenkinson, illustrated with photographs by Karl Lernberger.* In this text, two veterans of many river voyages offer an exciting new guide to river running, show exactly how to go about it, what to bring, and where to obtain essential river information. **$12.95**

67630. PEDIGREE: Words From Nature. *Stephen Potter and Laurens Sargent.* The spell-binding history of the origins of thousands of words making up the vocabulary of natural science. Written with gusto and rare narrative skill and full of unusual, interesting information. **$9.95**

36090. THE BEST OF BABCOCK. *Havilah Babcock.* A delightful collection of the matchless outdoor pieces by the late humorist, naturalist, and distinguished teacher, Havilah Babcock. A classic. **$8.95**

56530. ISLAND AT THE CENTER OF THE WORLD. *Father Sebastian Englert.* Easter Island's mysterious giant statues, the islanders' puzzling past, their lost language—new light is shed on them all here. Lavishly illustrated in full color. **$15.00**

Take any 3 books

(values to $42.90)

for only 99¢ each

as a member of the

Natural Science Book Club

if you join now and accept
3 more books—all at member
discounts—over the next 12 months

(retail prices shown)

55120. IN SEARCH OF THE RED APE. *John MacKinnon.* A former field researcher for Jane Goodall tells of his exciting three-year study of the orangutan in the wild jungles of Borneo and Sumatra. Filled with captivating descriptions of the stone-age natives, a dazzling variety of animals and the incredible adventures he encountered. **$7.95**

48675. FLIGHT TO FREEDOM. *Kent Durden.* "Like the eagle he loves, Durden is a vanishing species. He has expertise, he sees what he observes, and puts both into words that make unforgettable reading. In this book he even surpasses his first classic, *Gifts of an Eagle*."—*George S. Small,* author of *The Blue Whale* **$5.95**

65650. ON THE TRAIL OF THE FEATHERED SERPENT. *Gene Savoy.* Was there pre-Columbian communication between the Incan and Aztec civilizations? A veteran explorer tells how he became convinced there was and recounts the incredible, 2000-mile ocean journey he conducted to prove it. **$10.00**

63850. NATURALIST IN THE SUDAN. *Charles Sweeney.* A well-known English naturalist vividly recounts his experiences and observations in this wild, primitive country. An unusual blend of adventure, personal anecdotes, and natural history. **$8.50**

36520. THE BONE HUNTERS. *Url Lanham.* Absorbing history of the nineteenth-century adventurer-scientists who startled the scientific world, shattered many near-sacred illusions, and laid the foundations of modern paleontology. Filled with rare old photographs. **$12.95**

37540. THE CHEETAH. *Randall L. Eaton.* The first thrilling, exhaustive examination of this endangered species—what forces threaten its survival, and what must be done to preserve it. All the vital aspects of the beautifully spotted animal—life history, ecology, conservation, social behavior, reproduction, and captive behavior. **$12.95**

36790. BRAIN CONTROL. *Elliot S. Valenstein.* A thorough, balanced presentation of an important topic—major attempts to modify the brain through physical intervention and shock treatment. "Simply put, this book is a masterpiece."—*William Uttal,* Professor of Psychology, University of Michigan. **$9.95**

80972. STUDIES IN ANIMAL AND HUMAN BEHAVIOUR. *Konrad Lorenz.* Important two-volume compilation of Nobel Prize winner Lorenz's most valuable contribution. From the biological bases of human behavior to the social relationships of animals. *Counts as 2 of your 3 books* **$23.50**

39635. COMETS, METEORITES AND MEN. *Peter Lancaster Brown.* "... a magnificent survey of the history of comets, the theory of comets, and some of the unusual comets..." fills a notable gap in the popular literature, here is a book you can get your teeth into."—*Dr. Simon Mitton* in *New Scientist* **$12.50**

55200. THE INCREDIBLE EGG. *Dal Stivens.* Explores the range of mating, nesting, and protective behavior that has brought tens of thousands of backboned, egg-producing creatures alive and well through millions of years of unending competition for food and space. **$9.95**

63061. MOONS AND PLANETS. *William K. Hartmann.* An outstanding introduction to current knowledge of the solar system. A masterpiece of factual information. **$12.95**

Url Lanham
THE BONE HUNTERS
THIS LIVING REEF
DOUGLAS FAULKNER

69565. THE PORPOISE WATCHER. *Kenneth S. Norris.* A scientist who has devoted his life to the study of marine mammals provides a fascinating account of his experiments with porpoises and whales. An excellent introduction into marine biology. **$7.95**

36141. BEYOND STONEHENGE. *Gerald S. Hawkins.* Stargazers? An internationally famous astronomer unravels the astronomical significance of ancient Egyptian temples, Mayan ruins, drawings in the Peruvian desert, and the huge geometrical earthworks of the U.S. **$10.00**

If card is missing, simply write
Natural Science Book Club
Dept. 4-93A, Riverside, N.J. 08075
and indicate 3 books you want.

You can hear the quality of this vintage Bracket Clock every quarter hour: the pure tones of its Westminster Chimes are enhanced by the rich resonance of thick solid native black walnut in a case assembled with cabinet-maker precision. Your descendants will rely on it as confidently as you will! Lasting accuracy is ensured by a genuine Erhad Jauch 8-day keywind movement of solid brass and nickeled steel, with jeweled escapement and chimes that automatically synchronize to the hands. Solid brass dial has silvered hour ring.

Sold subject to your approval after using 30 days. (If you are not well pleased, return clock for full refund.)

$179 delivered.
Check, BankAmericard or Master Charge.
Ala. res. add 4% tax.

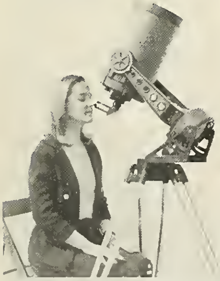
Do-It-yourself kit **$119**

complete with dial, assembled movement, chimes and hardware. Door assembled, other wood parts cut and sanded.

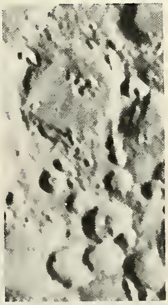
Brochure on request.

CROWN CLOCK CO.
P.O. Drawer G-19,
Fairhope, Ala. 36532

Celestron® **Multipurpose TELESCOPES**



The Celestron 8, with equatorial wedge and tripod, a portable observatory for the serious amateur astronomer.



Lunar craterlets. A 1-sec. exposure with the Celestron 5 tabletop observatory.

Dust lanes in the Andromeda Galaxy. An 8-min. exposure with the Celestron 8-inch, f/1.5 Schmidt Camera.

Large observatory telescopes optically folded into compact portables. Razor-sharp Schmidt-Cassegrain optics. These telescopes really make high power worth using! Perfect for serious amateur astronomers, nature observers, educators. Ideal for field trips in astronomy, biology, geology, archeology, architecture and ecology.

Celestron 5. A 12-lb. tabletop observatory, bannister telescope. Observe or photograph moon, planets, nebulae. Inspect the wing feathers of a blue jay at 1,000 ft. (Base Price: $750) Celestron 8. Portable observatory for examining the polar caps of Mars, ever-changing belt structure of Jupiter, stellar spectra, filamentary detail of deep-sky nebulae at up to 500X. Also, the ultimate telephoto lens! ($965) Celestron 14. World's largest one-man-portable observatory scope! Reveals numerous subdivisions in Saturn's rings, dust lanes in remote spiral galaxies, yet easily fits into your compact car. ($3,750) Also available: Schmidt Cameras — 14-in., f/1.7 ($3,150); 8-in., f/1.5 ($950); 5½-in., f/1.65 ($625) . . . Cold Cameras . . . Complete astrophotographic labs.

WRITE FOR YOUR FREE COLOR CATALOG

CELESTRON	5″	8″	14″
Useful powers	25-300X	50-500X	50-850X
Light grasp (vs. eye)	188X	510X	1,760X
Photographic speed	f/10	f/10	f/11
Resolution (arc-secs.)	0.8	0.5	0.28
Weight (lbs.)	12	23	108

Celestron Pacific 2835 Columbia / Box 3578-NH / Torrance, CA 90503

reasonable to suppose that some two billion years were required for the buildup of sufficient oxygen for respiration? Moreover, many extensive deposits between one and two billion years old contain large volumes of strongly oxidized rocks.

Berkner and Marshall's hypothesis embodied an attitude all too common among nonbiologists who do not appreciate the complexity that makes a simple machine a poor model for a complex living organism. Physical models often employ simple, inert objects, such as billiard balls, that respond automatically to the impress of physical forces. But an organism cannot be pushed around so easily; it certainly does not evolve automatically. The hypothesis of Berkner and Marshall relies upon the billiard-ball thinking that I term "physicalism"—metazoans arise immediately and automatically when a physical barrier to their existence is removed. The presence of sufficient oxygen, however, does not guarantee the immediate evolution of everything that could breathe it. Oxygen is a necessary but woefully insufficient requirement for the evolution of metazoans. In fact, enough oxygen probably existed for a billion years before the Cambrian explosion. Perhaps we should look to biological controls.

Steven M. Stanley of Johns Hopkins University has recently published a short and elegant article with a hypothesis so simple and evident that it almost has to be true.

Stanley bases his argument upon a recently demonstrated theory in ecology—the "cropping principle." The great geologist Charles Lyell argued that a scientific hypothesis is elegant and exciting insofar as it contradicts common sense. The cropping principle is just such a counterintuitive notion. In considering the causes of organic diversity, we might expect that the introduction of a "cropper" (either an herbivore or a carnivore) would reduce the number of species present in a given area: after all, if an animal is cropping food from a previously virgin area, it ought to reduce diversity and remove completely some of the rarer species.

In fact, a study of the distribution of organisms shows results that are opposed to this expectation. In communities of primary producers (organisms that manufacture their own nutrients by photosynthesis and do not feed upon other creatures), one or a very few species will be superior in competition and will monopolize space completely. Such communities may have an enormous biomass, but they are usually impoverished in species diversity. Now, a cropper in such a system tends to prey on the abundant species, thus limiting their ability to dominate and freeing space for other species. A well-evolved cropper will decimate its favorite prey species, but it does not destroy the prey completely (lest it eat itself to eventual starvation). A well-cropped ecosystem is maximally diverse, with many species and few individuals of any single species. Stated another way, the introduction of a new level in the ecological pyramid tends to broaden the level below it.

The cropping principle is supported by many field studies: predatory fish introduced in an artificial pond cause an increase in the diversity of zooplankton; removal of grazing sea urchins from a diverse algal community leads to the dominance of that community by a single species of algae.

Consider the Precambrian algal community that persisted for two and a half billion years. It consisted exclusively of simple, primary producers. It was uncropped and, for that reason, biologically monotonous. It evolved with exceeding slowness and never attained great diversity because its physical space was so strongly monopolized by a few abundant forms.

The key to the Cambrian explosion, Stanley argues, is the evolution of cropping herbivores—single-celled protists that ate other cells. This speeded the evolutionary clock to an unprecedented (and still unmatched) degree. Croppers made space for a greater diversity of producers, and this increased diversity permitted the evolution of more specialized croppers. The ecological pyramid burst out in both directions, adding many species at lower levels of production and adding new levels of carnivorousness at the top.

How can one prove such a notion? The original cropping protist, perhaps the unsung hero of the history of life, probably was not fossilized. There is, however, some suggestive indirect evidence. The most

"You can really get involved."

Sponsors report from around the country . . .

Castalia, Ohio — Sandy Prout, speaking for the St. John's United Church High School Class: "You can really get involved. It's a person-to-person relationship."

Her class is sponsoring a needy 13-year-old boy in Taiwan.

Seeley, Wisconsin—Emily Kochalka writes about her women's club sponsorship of a boy in the Philippines: "Our little lad warms all our hearts and makes us feel so proud that we are helping him. The warmth one gets from knowing you are helping a child is indescribable. Corresponding with the boy has brought home to us club members that we have so much—and children in other countries have so little by comparison.

"When the club sent Nestor $5.00 for his birthday, we later got a reply stating that the $5.00 meant 'the very best birthday I have ever had in my life.' "

Carlisle, Kentucky—Joseph H. Conley, project chairman for the Jaycees, expresses it this way in writing about a 12-year-old boy in Ecuador: "His improvement in health, grades, personality, activities during the period of this sponsorship has been remarkable. This is most satisfying to us."

Castlewood, Virginia—William A. White writes: "God has been good to me. I think a person should appreciate this and share it."

Barre, Massachusetts—Glenn Stratton, American Problems Instructor at Quabbin Regional High School, feels the sponsorship by his class serves the dual purpose of helping the child and instructing the students: "Students realize that what we take for granted is considered luxury by others, and tend to appreciate their own situation more fully."

Byron, New York—Mrs. Fern Griffen, of the Presbyterian Women's Association, says this: "Satisfaction in knowing we are helping this girl (in Guatemala) and perhaps others in her family by lifting their burden a little. She is very thankful and that makes us glad to help. The letters we get from Norma are so friendly and loving it makes us feel we have a daughter just over the way and we love her."

Would you or your group like to share in this person-to-person way of helping a child? You can begin by filling out the coupon and sending it with your first monthly check for $15.00.

You'll receive the child's photograph and information about the project where the child receives help. You may write to the child and the original letter will be sent to you, along with an English translation. (Housemothers or caseworkers help children unable to write.)

If you want the child to have a special gift on a holiday or his birthday, you may send a check and the whole amount will be forwarded to the child through our overseas staff, along with your instructions.

Won't you join the many sponsors who are finding a great satisfaction in this personalized way of helping deserving children?

Sponsors are urgently needed for children in: Brazil, India, Guatemala and Indonesia.

Write today: Verent J. Mills
CHRISTIAN CHILDREN'S FUND, Inc.
Box 26511, Richmond, Va. 23261

I wish to sponsor a ☐ boy ☐ girl in
(Country)________________
☐ Choose any child who needs my help.
I will pay $15 a month. I enclose first payment of $______. Send me child's name, story, address and picture.
I cannot sponsor a child but want to give $______.
☐ Please send me more information.
Name________________
Address________________
City________________
State________________Zip______

Registered (VFA-080) with the U.S. Government's Advisory Committee on Voluntary Foreign Aid. Gifts are tax deductible. Canadians: Write 1407 Yonge, Toronto, 7. NH17N0

Electric Potter's Wheel

Create your own ceramics with this unique, remarkably-priced bench-top potter's wheel that you and your family can have fun with anywhere in the house. Variable-speed drive adjusts faster for forming, slower for decorating. Comes with double-end shaping tools, non-toxic glaze and 4 water-soluble paints, artist's brush, potter's sponge, 3 lbs. air-dry clay and illustrated instructions for forming vases, pitchers, candlesticks plus design ideas to bring out the creative genius in you and your kids. No baking or firing required. Send check or money order to Kristi's, Inc., P.O. Box357h, Maugansville, Md. 21767.

$39.95
plus $3.00 Post. & Hdlg in continental U.S.

POTTERYCRAFT™ by GILBERT®

Because they're birds and they're free! So you have to change your photo habits. One ingenious solution is a zoom lens. It gives you a fast change of focal lengths without moving the camera from your eye.

The Vivitar Automatic Zoom lens goes from 85 to 205mm, opens up to an impressive f3.8 and isn't any larger than most standard 200mm lenses. The highly sophisticated optical design has 13 elements in 9 groups. The Vivitar Automatic Zoom is designed to fit most 35mm SLR cameras.

See a demo at your photo dealer or write for test reports by leading photo magazines.

Why don't birds stay where they are while you change lenses?

Vivitar Zoom Lenses

Marketed in the U.S.A. by
Ponder&Best, Inc.,
1630 Stewart Street,
Santa Monica, California 90406.
In Canada: Precision
Cameras of Canada, Ltd., Que.

abundant producer communities of the Precambrian are preserved as stromatolites (blue-green algal mats that trap and bind sediment). Today, stromatolites thrive only in environments, such as hypersaline lagoons, that are hostile to metazoan croppers. Peter Garrett found that these mats persist in more normal marine environments only when croppers are artificially removed. Their Precambrian abundance probably reflects the absence of croppers.

Stanley did not develop his theory from empirical studies of Precambrian communities. It is a deductive argument based on an established principle of ecology that does not contradict any fact of the Precambrian world and seems particulary consistent with a few observations.

In a frank concluding paragraph, Stanley presents four reasons for accepting his theory: (1) "It seems to account for what facts we have about Precambrian life"; (2) "It is simple, rather than complex or contrived"; (3) "It is purely biological, avoiding *ad hoc* invocation of external controls"; and (4) "It is largely the product of direct deduction from an established ecological principle."

Such justifications do not correspond to the simplistic notions about scientific progress that are taught in most high schools and advanced by most media. Stanley does not invoke proof by new information obtained from rigorous experiment. His second criterion is a methodological presumption, the third is almost a philosophical preference, the fourth is an application of prior theory. Only Stanley's first reason makes any reference to Precambrian facts, and it merely makes the weak point that his theory "accounts" for what is known (many other theories do the same).

But creative thought in science is exactly this—not a machinelike collection of facts and induction of theories, but a complex process involving intuition, bias, and insight from other fields. Science, at its best, interposes human judgment and ingenuity upon all its proceedings. It is, after all (although we sometimes forget it), practiced by human beings.

Columnist Stephen Jay Gould teaches geology at Harvard University.

IT TOOK US 90 YEARS TO MAKE THESE PENS.

We started making fine pens back in 1884, when Lewis Edson Waterman designed the first practical fountain pen. And all the improvements we've made since then have gone into these pens.

Their elegant style—graceful contours, stunning surfaces, extraordinary balance and superb "feel"—has been created by some of Europe's finest designers.

And their flawless construction and performance are the achievements of accomplished craftsmen, carrying on a 90-year-old tradition of excellence.

Waterman fountain pens, ball pens, refillable soft tips and mechanical pencils are designed in heavy 23.3K gold (97.08 per cent pure) electroplating, sterling silver, chromium and stainless steel.

Priced from $90 down, they're found wherever fine gifts are sold.

WATERMAN®
The elegant way to write.

The Graceful and Rapacious Weasel

The combination of heredity and climate can change brown to white

by E. Raymond Hall

"Something has killed every one of the young chickens!" The high pitch of my mother's voice (which I can still recall after more than half a century) quickly caught my father's attention. His investigation disclosed that two dozen chickens, all in the pinfeather stage, were indeed dead. A knothole high up on one side of the stout wooden packing crate that served as a chicken coop was the only entrance the marauder could have used. At the base of each bird's skull were two punctures, about as far apart as the two upper canine teeth of a weasel. My father, knowing that a weasel could pass through any hole large enough for its head, reasoned that the culprit had left after vainly trying to pull the young, 2-inch-wide chickens through the 1½-inch-wide knothole.

I did not see a live weasel until six years later when I was ten years old. One of the first features I appraised was the shape of its body. It was even slenderer than I had imagined. Its handsome brown back and sides, white underparts, and sleek fur made me decide it was the most beautiful wild animal I had ever seen, and I found it difficult to accept the concept that it was as evil as earlier events had conditioned me to believe.

The legs, I noticed, were short. Twenty years after the knothole episode, while studying the anatomy of mammals belonging to the order Carnivora, I learned that a weasel's hind leg is barely more than half as long as its body (base of head to base of tail), whereas in raccoons, which have an average build for a carnivore, the two parts are of approximately equal length. The weasel's forelegs also are notably short. These short legs on a long, slender body may account for the long-tailed weasel's distinctive running gait, which I have twice observed. At every bound the long body looped upward, reminding me of a measuring worm.

Of the three species of North American weasels, the long-tailed weasel (*Mustela frenata*) is the largest. Males are about eighteen inches long, including the six and one-half inch tail. Females are generally two inches shorter, but the difference in size between males and females varies from one region to another. In New England the male is four inches longer than the female and slightly more than twice as heavy, weighing some eight ounces. This species occurs only in the New World—from southern Canada to Peru.

The least weasel (*Mustela ni-*

ED CESAR

JEN AND DES BARTLETT; BRUCE COLEMAN, INC.

JOE VAN WORMER; BRUCE COLEMAN, INC.

In parts of Canada's Northwest Territories, ermine are common in swampy areas where, during spring, they feed on goose eggs and goslings.

valis), inhabiting North America, Great Britain, Europe, and Russia, is both the smallest animal of its genus and the smallest member of the order Carnivora. The third species, the ermine (*Mustela erminea*), is intermediate in size between the other two.

In the fur business, the white winter pelts of all three species are marketed as "ermine," justly esteemed for its luster in artificial light. Brown-furred winter pelts are marketed simply as weasel.

In the long-tailed weasel, the underparts are always white or whitish; the upper parts are some shade of brown in summer but, depending upon the area they inhabit, change to white or a pale brown in winter. Because of the different patterns of molt in spring and autumn, some late nineteenth- and early twentieth-century scientists believed, as do some fur-trappers of my acquaintance today, that in autumn the individual hairs change color, while in spring a molt occurs. This confusion about the autumn color change continued to exist even after the naturalist John Bachman had, by 1839, correctly reported two molts, one in spring and the other in autumn.

The spring molt begins along the midline of the weasel's back and proceeds laterally down to the midline of the belly, producing at almost any given time a sharp molt line that separates the winter hair from the incoming summer hair.

The long-tailed weasel usually preys upon small rodents, often killing more animals than it can immediately consume.

The autumn molt takes place first on the belly, then on the sides, and finally appears over all of the animal's upper parts at about the same time, which gives the weasel a salt-and-pepper appearance if its winter coat is to be white. The spotty molt pattern reported in many captive weasels results from the unnatural conditions of cage life.

In October and November, nights in the Northern Hemisphere grow longer and days shorter, until a point is reached at which the diminished amount of light received through the weasel's eyes causes certain internal secretory glands to stimulate molt. At this season, the melanoblasts of the cells in the hair follicles of most weasels in Canada and the northern United States, where snow is common, do not have the pigment melanin. Consequently, hairs grown from such follicles are white.

In March and April the reverse process occurs. As the days grow longer and the nights shorter, the increasing amount of light received through the eyes again stimulates molt. But at this season, melanoblasts of the cells in the hair follicles have granules of melanin, which are incorporated in the cells of the growing hairs.

In the early 1890s, by skillful sectioning, staining, and microscopic observation, the German microanatomist Gustav Schwalbe discovered that in spring the hair-forming cells of ermine have pigment, but in autumn they do not. In the early 1940s Charles P. Lyman of Harvard discovered—by masking the eyes of varying hares (hares that have white fur in winter)—that the molt signal was received through the eyes. At about the same time, Thomas Bissonnette and Earl Bailey at Trinity College in Hartford, Connecticut, confined in a room ermine from an area where they were white in winter. When the animals molted, the investigators substituted artificial light for daylight and, at intervals, reversed the length of the periods of light and darkness in a 24-hour time span to alternate the amount of spring light and darkness with autumn light and darkness. At the end of the molt period, the ermine were clothed in alternating longitudinal stripes of white and brown fur—unlike anything produced out-of-doors by nature in a free-living weasel.

In 1935 I discovered the band (*see map, page 49*) in which some long-tailed weasels molted into white winter coats and others molted into brown winter coats. This east to west band extends across North America from southern New England to Colorado, and westward, as a narrower band (reflecting the extent to which altitude compensates for latitude) at medium elevations on the southern ends of the Rockies and the Great Basin mountain ranges, before bending northward on the western slope of the Sierra Nevada and continuing into British Columbia.

To the south and west of this band, all long-tailed weasels molt to brown coats in both spring and autumn, but to the north and east of this band, they molt in autumn into white winter coats and in spring into brown summer coats.

To examine coat color, I moved some weasels from each side of the band to the opposite side and left them there through the autumn. The moves were along a single line of latitude so the amount of daylight and darkness would not differ on the two sides of the band.

In the summers of 1936 and 1937, a male and two females captured on the warm, snow-free coast of California, where all weasels have brown winter coats, were transported eastward to Lake Tahoe high up in the cold Sierra Nevada, where weasels have white winter coats as befits the snowy terrain. Conversely, a female from Lake Tahoe and a male from northern Utah, where the winter coat is white, were transported westward to the warm coast of California. These long-tailed weasels were in every instance kept in outdoor cages that had wire-mesh sides open to the elements.

In ensuing autumns, the animals molted at the usual time in normal fashion. In every instance the resultant winter coat was the same as it would have been at the animal's place of origin and unlike the coats of weasels in the areas to which the captives had been transported. The

JEN AND DES BARTLETT; BRUCE COLEMAN, INC.

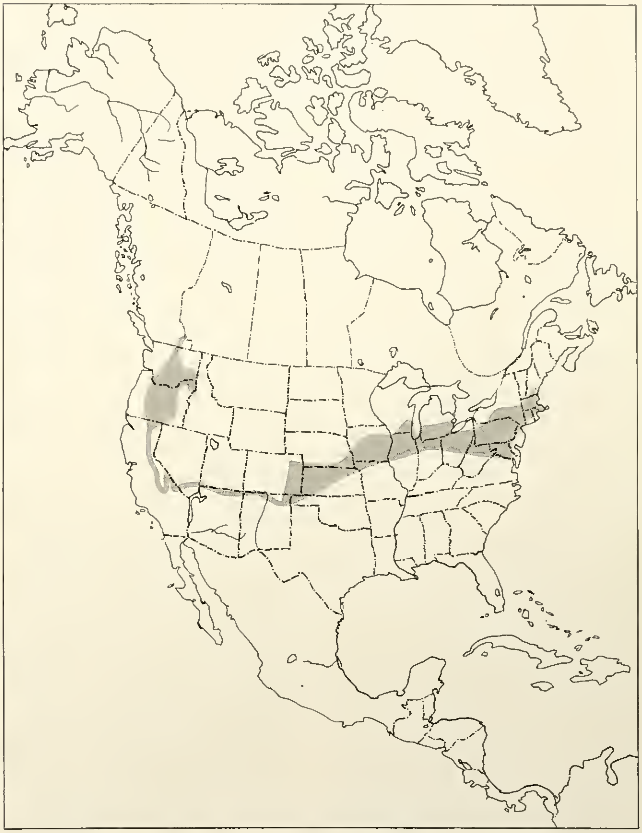
results are strong evidence that heredity, rather than temperature or the presence or absence of snow, determines the color of the winter coat.

I believe the underlying cause of white winter coats and brown winter coats is protective coloration achieved by natural selection over long periods of time. Long-tailed weasels are always white in winter if they are from areas where snow lies on the ground all winter, every winter or almost every winter; and they are always brown if they originate in areas where it never or rarely snows.

Lest the reader infer that the change in coat color is completely understood, throughout the region covered by the horizontal band, males with brown winter coats and males with white winter coats are to be found at the same places. But in the northern fourth of that band all females are white, and in the southern fourth they are all brown. Consequently, the band having two colors of females is only half as wide as the band having two colors of males. The reason for this secondary sexual difference is not known.

In relation to its weight, the long-tailed weasel is unsurpassed, perhaps unequaled, among mammals in the effectiveness with which it exercises its carnivorous heritage.

The ermine, (Mustela erminea), *left, ranges across northern Canada. The long-tailed weasel* (Mustela frenata) *ranges from southern Canada to Peru. In the United States, long-tailed weasels that inhabit the area shown as a black band on map, below, molt into either brown or white winter coats. Long-tailed weasels north and east of this band molt into white winter coats; south and west of band, they molt into brown winter coats.*



It kills with speed and strength a wide variety of animals, including some much larger than itself. The teeth are highly specialized for a diet of flesh, the degree of this specialization being second only to that of the cat family. The first lower molar, as in the cats, lacks the internal cusp. The heel of that tooth is a blade for cutting food rather than a basin for crushing it. The long, daggerlike canine teeth are effective in stabbing a victim to death. This specialization for a diet of flesh is fully as evident in the immature dentition as in the permanent dentition.

Ecologically, one long-tailed weasel represents the capstone of a five-layered food pyramid. The horizontal layer immediately below consists of an annual crop of some 1,300 native mice, resting on a broader layer of 30,000 succulent grass stems, supported from below by an even denser layer of many tens of thousands of rootlets, which with the help of soil organisms extract an infinite number of chemical molecules from the fifth layer—the soil. Understandably, the weasel is rare compared to any one of the species upon which it preys.

In eastern Kansas, when December snow blanketed the ground, I have often observed weasel tracks along a fencerow where sprouts of Osage orange had been cut and piled on the ground, and along a creek bank where a fringe of uncut grass afforded cover for small animals. In both instances, tracks of deer mice and meadow mice were more abundant than in other places, and the scent or sight of the native rodents had probably attracted the hunting weasels. Numerically, these two species of mice in the midwestern and eastern United States make up slightly more than half of the twenty-six kinds of creatures on which the long-tailed weasel preys.

In the western United States, pocket gophers are favorite prey of long-tailed weasels. In some regions these gophers are regarded as nuisances because of the frequency with which they eat alfalfa plants in irrigated meadows and native plants in mountain meadows where livestock is grazed.

We can understand, therefore, why the long-tailed weasel is sometimes referred to as the farmer's best friend, even though this statement is an oversimplification of a biological relationship. I once observed a female weasel and her three offspring living in a pocket gopher burrow in a meadow along Baker Creek, Nevada. A second female and her young lived about two hundred yards to the west in another pocket gopher burrow. About fifty yards to the south of the entrances to these burrows, an adult male lived alone in another burrow. Had I not removed the long-tailed weasels for a study, they probably would have cleaned out the entire population of pocket gophers in this small meadow before moving on to another place.

The female pocket gopher and the female weasel weigh about the same; the male pocket gopher is approximately a fifth lighter than the male weasel. Considering the weight of the pocket gopher and the apparent frequency with which pocket gophers and weasels are captured in the western United States, the gopher is important to the weasel there both as food and as a maker of burrows. But the long-tailed weasel also occurs throughout the eastern half of the United States, whereas the pocket gopher does not inhabit most of that region.

Weasels reportedly kill greater numbers of rabbits—of one species or another—than they do of any other animal equal in size to, or larger than, themselves. Durward L. Allen, who has studied the weasel–rabbit relationship in detail, concluded that the weasel was more successful in killing a full-grown cottontail if it was inside a burrow rather than outside. Nevertheless, weasels have been reported pursuing rabbits for considerable distances above ground. Adolph Murie once observed such an instance in Minnesota one mid-November morning when six inches of fresh snow covered the ground. From the top of a thirty-foot spruce he watched a weasel and a varying hare, both in white pelage, and recounted the following observation:

> My attention was first attracted to the hare as it came hopping steadily but unhurriedly from the north. Directly in front of me . . . the hare crisscrossed back and forth at various angles over an open area about 20 feet in diameter. After producing a maze of tracks, the hare "froze". . . . In a few minutes the weasel appeared, all his faculties focused on the warm trail. Expertly he followed its convolutions, passing at times within a few feet of the watching hare. Not until the weasel had followed every turn of the trail to within three feet of its termination did the hare skip off. It came out to the road almost directly below me. . . . At the road the weasel lost the trail . . . and then ran parallel with it, once more in hot pursuit.
>
> Ten minutes later the hare emerged . . . came on directly to the tracked-up area, and continuing its stratagem, leisurely hopped about to leave its zigzag trail. . . . The weasel['s] . . . nose led him through the network with little trouble. He was almost upon the hare before it jumped off and followed the same path.
>
> The hare had to show his big heels [a third time] . . . as the weasel approached him. This time the weasel failed to follow. . . . After examining a few brush heaps he vanished into the woods behind me.

Relying to a great extent upon the scent of its intended prey, the long-tailed weasel hunts by day or night.

Almost every naturalist who has studied the food habits of weasels has found that the long-tailed weasel will prey upon one species of animal if that species is continually available. The size of the population of the prey species varies from year to year and from season to season. At times, a weasel will kill many more individuals of a prey species than it can immediately eat. Ordinarily, it stores the surplus for possible future consumption, with much the same objective that squirrels have in gathering and storing nuts.

Birds, although acceptable as food, rarely make up the principal diet of weasels. The late naturalists Norman and Stuart Criddle of Manitoba, commenting on the economic role of the long-tailed weasel and on its capacity to shift to birds when populations of small mammals are unavailable, stated:

> In the last twenty years we have permitted weasels to frequent the farm buildings at will and the poultry house has been no exception. In that time rats and mice suffered severely from the weasels, while the total number of poultry taken were six. Many times that number, however, have been killed by rats.

In 1970, on my mother's ninety-fifth birthday, I asked if she remembered the tragedy, 64½ years earlier, associated with the weasel and her young chickens.

"Yes," she said.

I read to her the Criddles' estimate of the long-tailed weasel's economic role, but thought of nothing to add when she said, "Different people like different kinds of animals." ☐

JOE VAN WORMER

Stripping the Appalachians

"Like some darkly creeping miasma, all over the mountains the cogs mesh in the machines"

by Branley Allan Branson

No mountains—not even the mighty Rockies or the towering, grandiose Cascades—have affected the course of history in North America as have the Appalachians. For a hundred years they held back the spread of European civilization into the wilderness of the West, until Daniel Boone, John Sevier, and others hacked out the Wilderness Road and breached the Cumberland Gap. And what would have been the fate of New York City had not the broad, fertile Hudson River Valley penetrated the Adirondacks?

The settings and scenes expanded by the restless imagination of James Fenimore Cooper in his *Leatherstocking Tales* symbolized a change in the thinking of nineteenth-century Americans, not only toward the vanishing estate of the Indian but also toward the generalized degradation of the Appalachians by transplanted Europeans.

Some men did not simply pass through these low mountains on their way westward; they chose to make their homes in them, and their descendants still remain. So do many archaic ways—clans, folk dances, hints of Gaelic, homemade musical instruments, moonshine.

The Appalachian mountain system, which includes the Adirondacks, the Green Mountains, the White Mountains, the Catskills, the Smokies, and the Cumberlands, is ancient—170 million to 230 million years old. Extending from Quebec to northern Alabama, the mountains show their advanced maturity in their long, depressed, rounded, and undulating terrain—the results of weathering and erosion over time. Young mountains are bold, craggy, and declivitous like the Rockies.

There is no finer sight than the gentle, wooded slopes and verdant valleys—crisscrossed by serpentine, sparkling streams—of the Appalachians in spring, when mountain laurel, rhododendron, dogwood and redbud perfume the air. On walks through the fall landscape of golden tulip poplars and scarlet maples and oaks, I have exposed many cartridges of color film, but I have always failed to capture the essence of the montane beauty. It is something one has to experience—as one does the size of redwoods—to appreciate the magnitude of the beauty and serenity.

There are many parts of the Appalachians that are not familiar to most Americans; it is possible they were unfamiliar even to the settlers who pioneered their way through them two hundred years ago. Today's frantic travelers who drive the freeways and turnpikes, contemplating only the drill and blast marks in the sedementary rocks, the Australian crown vetch planted in an attempt to halt erosion, and the neat rows of white pine designed to hide the scars of surface mining, little realize that there are still remnants of what Appalachia looked like in pre-Columbian days. It takes a little strenuous walking to get to these places, but they do exist.

One of the most enchanting wilderness areas in the southern Appalachians lies sequestered in the sharply pitched palisade and cliff country of Wolfe County, in north-central Kentucky. It is an area of crystal creeks and 200-foot-high sandstone cliffs, of gigantic hemlocks and tulip trees rising from the shadows of the forest floor. It is a country of moss, where decaying logs lie in the same positions they have occupied since they fell from old age and death. Tight Hollow has retained its pristine form because of its inaccessibility.

But this particular kind of inaccessibility is swiftly becoming part of a bygone era. The concentrated study and application of efficient new mining techniques has opened the hills and mountains of Appalachia to increased rapine.

Coal mining in the eleven-state area usually referred to as Appalachia is not a new blight. The office of the U. S. Geological Survey estimates that coal deposits occur in approximately 50,000 square miles of the region, primarily in Pennsylvania, West Virginia, Virginia, Alabama, Ohio, and Kentucky. Before the beginning of World War II, most of the coal in Appalachia was secured from shaft mines, which could be—but often were not—sealed after the coal was removed.

After 1940, surface mining became progressively more popular, and decades of both methods of

Large mechanical shovels remove up to 200 tons of overburden in one bite, revealing deposits that are then mined by smaller shovels.

P.B. KAPLAN

P.B. KAPLAN

The Silver Spade is one of two electric shovels operated in eastern Ohio by the Consolidation Coal Company. It moves ¼ mile per hour, its 14 engines are rated at 13,500 horsepower, and its scoop can hold 315,000 pounds of earth. The gondola truck at right, with a load capacity of 100 tons, carries coal from mining areas to railroads or highways.

mining in the Appalachian region have caused severe deterioration of streams, seriously limiting industrial and domestic use of such waters, and often causing economic restrictions at downstream localities. The amount of land thus afflicted has steadily increased. According to the National Coal Association, about 65,000 new acres per year are attacked in Appalachia. Today, more than 1,500,000 acres are either mined or affected by mining.

Surface coal-mining operations are not all alike. They vary according to the terrain where the deposits occur. Relatively flat lands are usually mined by stripping; draglines, scoops, and other gear operate directly on the coal seams being excavated. This method is used in western Kentucky, Oklahoma, Kansas, and other areas of low terrain. It produces long, parallel rows of peaked spoil banks, 10- to 30-feet high with 49° to 60° slopes. Between the spoil banks are pits of 16 acres or more, which soon fill with water.

In hilly or mountainous terrain, contour stripping is used. In this technique L-shaped notches are incised into the mountainsides leaving spectacular, 50- to 60-foot-high walls. The spoil materials are simply bulldozed down the slopes. When the mountain is cut so thin that it can no longer be stripped, corkscrewlike augers bore parallel rows of holes into the remaining coal seams in order to bleed out the last dollar's worth of carbon.

The ecological impact of surface mining in any given area is massive. It completely alters the entire topography, destroying all original vegetation as well as most of the animal life and leaving barren rubble behind. The use of fertilizer and calcium in such areas to reduce the acidity of disturbed soil will allow something to grow; how close this growth is to what normally would occur in the area is another matter. Fields of low-growing legumes, love grass, and crown vetch, with a scattering of locust trees and pines, are scarcely a native forest.

Clastic rocks, lying deep beneath a blanket of protective topsoil, forest litter, and growing vegetation, weather very slowly and take centuries to erode. Under natural conditions, rainwater or snowmelt runs off slowly and percolates gently through the soil and rocks, entering streams in a clear state, carrying only minimal amounts of the chemical substances that occur in the watershed. The release of these substances into the water is controlled by a complex chemical equilibrium that allows only trace reactions to occur.

Only changes in the chemical composition of percolating water or massive disturbances of the surface rocks and soil can upset such an equilibrium. This is exactly what surface mining does. Many new clastic rocks are exposed, and entirely new, long-term equilibriums must be established. In the meantime, runoff carries greatly increased amounts of spoil-bank materials into nearby streams.

The most important substances contained in overburdens are siderite (iron carbonate) and various forms of iron sulfide, including pyrites and marcasite. Siderite is not as dangerous to living things as iron sulfide, although in streams afflicted by surface mining, an obvious increase in the siderite level may be used as an index of mining pollution. Siderite usually reacts with water to produce harmless gases and insoluble substances, which precipitate from the water.

When iron sulfide comes into contact with water and oxygen, however, the negative aspects of surface mining are most evident. Pyrites alter easily to ferrous sulfate, fairly harmless in moderate quantities (although it is the main substance investigators use to measure mine pollution), red- or yellow-colored hematite and limonite, and the extremely lethal sulfuric acid, which is the culprit in hundreds of fish kills. Kills often involve 100,000 or more fish, and sometimes, as in the Gila River at Clifton, Arizona, in 1971, as many as one-third of a million.

Many streams are completely decimated by acid-mine runoff, and even in small creeks the dollar-and-cent loss may exceed $10,000 for a single occurrence. But it is not only the fish that suffer when this happens—whole ecosystems wither a

P.B. KAPLAN

4

Appalachia's abundant valleys and rolling peaks harbor some 50,000 square miles of coal deposits.

JAMES R. SMITH; PHOTO TRENDS

little. All local terrestrial animals that feed on fish—grebes, mergansers, loons, mink, raccoons, and many others—are reduced in numbers.

Acid drainage occurs primarily in areas of moderate rainfall, particularly where gentle winter rains leach pyritic materials from the exposed overburden, and where intensive spring and summer rains then flush the materials into streams, causing high concentrations of acid. This problem is most frequent in the Appalachian coal fields.

Investigators have recently brought to light a new aspect of acid-producing overburden. Bituminous coal (the larger portion of surface-mined coal) usually contains various types of sulfates. Several investigators have determined that sulfur- and iron-oxidizing bacteria may cause an increase in the amount of acid that enters streams from fresh overburden. Apparently the bacteria, which utilizes inorganic materials rather than living tissues as a source of energy, can cause a 250 to 450 percent increase in the amount of acid formed from sulfur balls and pyrites, which are rich in sulfates.

In addition to the devastation to vegetation in the immediate vicinity of stripping, aquatic plants usually disappear from nearby streams. And in those ponds in which the water is acidic or saline, plant growth is either absent or greatly retarded because the tender roots cannot absorb essential elements as efficiently. Such ponds are bright green, probably due to increased iron solubility. In Ohio some of these ponds are nearly seventy years old, and they show no signs of changing their character.

The Peabody Coal Company, a subsidiary of the Kennecott Copper

Each year 65,000 acres of the Appalachians are mined; until recently, they have been left ragged and barren.

Corporation and one of the largest coal companies in Appalachia, claims that the creation of fishing lakes is one of the coal industry's strong points. No doubt some of the strip-mine ponds and lakes do produce fish—but anybody can pick and choose the best examples of what he is attempting to demonstrate. William Lewis of the Illinois Natural History Survey and Claude Liest, formerly of Kansas State College, hold opinions contrary to those put forth by officials of Peabody Coal. Strip-mine pits usually have little or no shallow area where fish can reproduce. Where shallow waters do exist, massive overpopulation and stunting result because of the innate tendency of pond fishes to reproduce in very confined quarters. Possibilities for the balanced production of fish in most strip-mine ponds are impractical or impossible or, at the very minimum, economically unfeasible. The limited accessibility of most of these ponds to fishermen is another disadvantage.

Silt, the most widespread pollutant in North America, is one byproduct of strip mining, but the general public remains unaware of the extent to which ecosystems are harmed by silt pollution. In a study of the effects of strip-mine siltation on the fish and invertebrate populations of streams, Donald L. Batch and I selected two strip-mining afflicted streams in Kentucky that lay in geologic formations low in acid-producing substances. Our preliminary observations indicated that strip mining increased siltation by as much as fifteen to thirty times.

On undisturbed, forested slopes, erosion is quite slow; less than a ton of soil per acre is carried away by runoff waters. But the extent of mining, the slope of the area, and the amount of rainfall can increase soil loss from seven or eight tons per acre to more than four hundred tons per acre. Rock and soil are transported by the rushing water or are held in suspension by being bounced and rolled along the stream bottom, depending on water velocity. The current in the stream, of course, depends on the shape of the basin and the roughness and slope of the stream bed. Material is deposited whenever the energy of the water flow is reduced, such as when the stream widens or forms backwater pools. The largest particles drop out first and then the smaller.

The usual composition of outwash from spoil banks is predominantly clay, with some silt and sand and a mixture of lesser materials. About 10 percent of these materials erode from access roads; this is about 2.6 inches per year or approximately 3,776 tons per mile of road.

The combined sediments delivered to a stream during a storm may amount to as much as 112,000 parts per million, contrasted with 30 to 100 parts per million in unaffected streams of equal size. Deposits of silt are seldom deeper than two inches in unaffected streams, but in polluted streams we have measured deposits that are well over two feet deep. The result of such masssive quantities of silt is that the water-carrying capacity of more than 60 percent of headwater streams in the area is reduced by two-thirds or more. The sediments are carried downstream to larger and larger tributaries and finally into the major rivers. Flooding increases greatly whenever this situation occurs.

In an apparent attempt to prevent some silt from reaching stream level, strip miners have begun building silt-catching dams—right across the middle of upstream segments of the channels they are ostensibly trying to protect. But dam building means more access roads and more disturbance to the drainage basin. During the construction of such dams, the silt load often exceeds that being delivered to the stream by spoil-bank erosion. The consequence is that such dams often quickly fill with silt and wash out, sometimes with tragic results when people's lives and homes are lost.

The creeks we selected for research were very small—one was only two miles long and the other three and one-half miles in length. To determine silt loads and water-level fluctuations we installed concrete weirs with V-shaped spillways and recording devices housed in permanent, locked chambers at critical points on each stream. Weekly water samples were analyzed. In addition, we selected six fish- and invertebrate-sampling stations in order to include as many habitat types as possible. We also conducted a food-habit study on the creek chub (*Semotilus atromaculatus*) because the species exhibited some resistance to excessive siltation of its habitat waters.

We found that before the onset of mining the fish and bottom fauna exhibited the typical arrangement of most mountain streams—species and numbers increased as we progressed from the source to the mouth. Thus, we observed nine genera and seventeen species of fishes in Bear Branch Creek and a slightly lower number in Leatherwood Creek where mining had begun before our study was under way.

At the beginning of the study, the mouth of Bear Branch held about 15.4 pounds of fish per acre; at the end of seventeen months we measured only 8.6 pounds per acre. Since the pH (a scale for expressing both acidity and alkalinity) of the studied waters was acceptable for fish life, 5.6 to 7.8, mostly around 7.0, we had to look elsewhere for an answer to why the fishes were diminishing in numbers.

During the early stages of the investigation, both creeks were crystal clear, and the bottoms were virtually free of silt. After mining, silt loads of more than 3,000 parts per million were not uncommon, and the bottom of the streams quickly became laden with silt. The bottom flora and fauna were nearly eliminated; insects and crustaceans, for example, were reduced 90 percent.

Analysis of fish data made it clear that elimination of the fish fauna started in the headwaters and progressed downstream. Species

P.B. KAPLAN

were either driven downstream by increased silt loads or eliminated from the local faunas. Since most of the fish living in streams of this type are bottom feeders, their elimination was primarily due to the disappearance of the bottom-dwelling insects and crustaceans on which they fed. During later visits, although we secured many egg-laden females and sexually mature males, we found no young fish. Either reproduction had been curtailed or the eggs or fry–or both–had been smothered by silt. The creek chub remained long after other fishes had been eliminated because this species feeds primarily from the surface on terrestrial-type insects, but it, too, is gradually being eliminated from the streams since the silt interferes with reproduction.

Although the disappearance of fish life as a result of silt may not be as dramatic as acid-mine water kills, it is a stealthy, disruptive killer in Appalachia. In instances where a rare or endangered fish is involved, such as the beautiful arrow darter (*Etheostoma sagitta*), a small perch, the result may well be complete extinction unless something is done to protect its habitat. The situation in the entire upper Kentucky River Basin, as well as that of the Cumberland, looks very bleak indeed, for mining operations are constantly being intensified and accelerated to meet the growing demand for coal.

According to our investigations, only a few of the small strip-mine operators, out of a residual, real feeling for the land, attempt good reclamation. The most common form of reclamation practiced in Appalachia consists of partial grading and screen planting—rows of trees, often white pine, planted along highways to screen the devastation from view. Reclamation is feasible only in relatively flat terrain, but even there screening often occurs. In mountainous country with 24 degrees or more of slope, attempts at reclamation are at least 80 percent unsuccessful, particularly in the case of tree planting. There is no attempt to reclaim haul roads.

In remote areas, little is done. The only feasible reclamation method in the mountains is to outlaw mining on slopes of more than 14 degrees. This is not apt to occur, however, since both the Tennessee Valley Authority, which uses more than 60 percent of Appalachia's coal, and the Appalachian Regional Commission are cool to the idea of limiting surface mining. Meanwhile, an entire mountain range, is in the process of being drastically changed.

The Peabody Coal Company has developed a master plan, called "Operation Green Earth," for developing surface-mined lands to usefulness and attractiveness as quickly as possible, but by their own admission, Operation Green Earth does not create new land overnight. Some areas must weather for a long period of time—perhaps centuries—before the soil can support successful growths of trees and other vegetation. The U.S. Forest Service is conducting an extensive research project in an attempt to discover plants that can be used effectively to cover and hold spoil banks in place—crown vetch, a variety of grasses, and several kinds of trees, such as black and honey locust, pines, and even fruit trees. But most of the spoil materials pushed over the sides of mountains will move en masse down the mountainsides. None of the plant combinations tried thus far seems to offer a lasting solution to the reclamation problem in the Appalachian Mountains.

The impact of this activity has generated a startling number of countermovements by political aspirants and conservation groups. At the national level, several political figures, such as Senator Fred Harris of Oklahoma and Representative Kenneth Heckler of West Virginia, have run and won on anti-strip-mining platforms.

Whether or not politicians will be able to mount effective curbs against strip mining remains to be seen. Although it is obvious that the millions of words uttered during political campaigns may serve to increase citizen awareness of strip-mining issues, they scarcely hint at the raw political power that such companies as Kennecott Copper Corporation and its subsidiary Peabody Coal Company are able to exercise in effectively countering nearly every effort made by local and state governmental agencies to regulate mining activities.

Numerous small ponds and lakes, some of them overpopulated with fish, form in the pockets hewn out by mining machinery.

Legislation to control strip mining, however, is now in Congress. In July, the House of Representatives passed a bill that, although oriented toward strip mining in the West, does provide for the reclamation of strip-mined land, bans highwalls, requires the stabilization of spoil banks, and prevents the accumulation of waste material on steep banks. This bill is now being combined with a tougher Senate bill that was passed last year. Both houses are due to vote soon on the combined bill.

We write much about energy crises—of our national struggle for existence at a level to which we have become habituated. No doubt there is some truth in what we say, but more pressing, more delicate, and more ephemeral in the wake of wholesale permissiveness in energy removal is the singular principle known as ecological balance, which leaves all other considerations nearly weightless by comparison. That without this balance whole ecosystems are in peril is obvious. Yet, like some darkly creeping miasma, all over the mountains the cogs mesh in the machines, and while we argue trivial points of jurisdiction and time schedules, the Appalachians continue to fall. When the wind blows straight across the barren, moonlike surfaces of Appalachia, and the dust rises and beats endlessly against the spring traveler's skin, I remember the green wall of forest that used to thrive there, the bright streamers of water that laced the rills. And as I walk across the desolate sands, it is the magic of memory that assures me of sanity. ☐

P.B. KAPLAN

Island of Saints, Scholars, and Scléip

Although their lives are hard and their spirits sometimes low, the people of Inis Beag maintain a rich tradition of humor

Text and photographs by John C. Messenger

Just as Ireland itself has long been known as the "Island of Saints and Scholars" so, too, has each island of a group situated off its west coast. The smallest of these islands is 1,440-acre Inis Beag. A large strand and a tract of common land dominate the island's eastern side. Four villages range to the west on several terraces that build up sharply to a plateau more than 200 feet in height, which then slopes gently to the Atlantic a mile away. The terrain, part arable soil and part fissured-stone pavement, is quartered into strips extending from the communities to the "back of the island." Each landowner possesses numerous small plots, bounded by rock fences, located along the quarter his village fronts.

The 350 islanders subsist by farming, herding, fishing, boarding tourists, and manufacturing craft objects for export. Their scant incomes are supplemented by a variety of government subsidies and by remittances from kin who have emigrated. Several kinds of crops are grown, but the potato is by far the most common. Islanders raise cattle, sheep, goats, horses, asses, and smaller livestock, both for sale on the mainland and to provide most of their food, clothing, and transportation. During clement months, some of the men fish with nets and lines from the famous *curach,* or coracles—small wicker frame boats covered with tarred canvas—which the fishermen row with consummate skill, often far out to sea.

Although my wife and I focused our research on all aspects of the contemporary culture of Inis Beag, the subject of humor was a special category in our field notes.

The word *scléip* in my Irish-English dictionary translates as "jollification"—a colloquialism often heard in Ireland—which means "merrymaking, revelry, festivity." For a people whose basic personality reflects such traits as sexual repression, hypochondria, depression, masochism, secretiveness, envy, jealousy, and feelings of inferiority, and whose behavior is governed by excessive fear of gossip, ridicule, and opprobrium, *scléip* may be too strong a word. But I desire to attract Irish enthusiasts—as well as any saints and scholars—among my readers, and also to uphold the archaic Irish tradition of alliteration in prose, poetry, and drama.

Nevertheless, the islanders of Inis Beag do have a well-defined tradition of humor, much of which is covertly expressed. Practical joking, gossiping, relating anecdotes, employing proverbs, and expressing verbal wit are everyday activities of most of the people, but the telling of folktales, the recitation of satirical poems, and singing usually take place before gatherings in pubs and homes. Jollification is approached only during the rare "great nights" at the pubs and the equally rare parties given in homes, mostly during the twelve nights from Christmas to Epiphany, after Easter, and in the late summer. But at these times drinking, set and step dancing, and singing, rather than humor, hold sway.

As to the objects of humor in Inis Beag, most are people in positions of authority, such as priests, policemen, and government officials who have direct contact with the peasants; those among themselves who behave in disapproved ways (who are, for example, indolent, superstitious, aggressive, or boastful); individuals from nearby islands; foreign visitors; and, of course, inquisitive ethnographers.

Local humor and its often covert expression first came to our attention on the third day of our initial visit to Inis Beag, when I was the victim of a still remembered and savored practical joke. Unknown to me, I had been observed lifting overhead ("repetition pressing," as weightlifters say) a barrel of Guinness stout. On the day in question, I was walking along the strand, when I was hailed by two men who asked me to help them carry a *curach* from its stone cot on the edge of the common land across fifty yards of loose sand to the water's edge. Usually three men carry a *curach*, bearing it upside down with the seats placed on their shoulders; this is a difficult task, since the craft can weigh as much as 700 pounds.

I obliged them, but after taking a dozen steps, I had to call on all my physical and mental resources to keep from collapsing before we at last set the boat down. I tried to conceal from them that I was breathless and faint; they, however, appeared fit, thanked me perfunctorily, launched the craft, and hastily rowed off. With equal haste I retired to my bed for several hours, thinking how right literary and film artists were to praise the immense strength of the "hero breed" (a term used by one writer). A week later, quite by chance, I learned that I had been put to the test that day. My mates had dipped their shoulders and only simulated carrying the *curach;* I had borne the full load.

This event, in addition to provoking glee whenever mentioned, created a rapport between the men and me thereafter, since strength is still a primary prestige symbol. Rapport with the children, however, was another matter. Because of my large size, robust manner, and frequently demanded feats of strength, harassed mothers used me as a threat in disciplining their children, a distinction I shared with the nurse and her hypodermic needle and the headmaster of the national school and his ruler. As a result, my wife was the collector of most of our data concerning children and child rearing.

Probably the most often recounted practical joke concerns the best liked of the islanders—a man of seventy-two years who is admired for his wit, charm, and friendliness as well as his singing and his agile step dancing. When drinking in the pubs, he enjoys telling anecdotes

Dressed in traditional homespun trousers and vest, a man walks along a stone path on the Atlantic island of Inis Beag. Behind him are small farm plots, bounded by rock fences.

about the real and imagined experiences of his youth, when he spent time as a farm laborer on the mainland (from which his nickname, "Countryman," derives). Although he is landless—a "man of few gardens"—and considered the most indolent person in Inis Beag, he is highly regarded for his verbal and esthetic talents and occasional *joie de vivre.*

The practical joke on Countryman was perpetrated when he was observed cutting potato seeds in early April. This prompted the joker to climb the wall of the island's castle and imitate the song of the cuckoo. Planting must be completed before the cuckoo arrives and sounds its call, usually in late April; the person who is still seeding when the bird is first heard is an object of ridicule (in some parts of Ireland he is known as a "cuckoo farmer"). When Countryman heard the cuckoo's call, he gave up his job in disgust and fed the seeds to his poultry.

One practical joke involved a new curate, and while humorous anticlerical gossip and anecdotes abound in Inis Beag, this was the only example that came to our attention of a priest being the butt of a practical joke. (Anticlericalism, which courts divine punishment, is seldom manifested in overt acts.) Of three medieval chapels on the island, one is supposedly buried beneath the strand; only legend supports its existence, as there is no reference to its original appearance in the earliest writings. Nevertheless, funeral processions bound from the present chapel to the cemetery leave the main path to follow an ancient one deep in the sand, and at the point where tradition asserts that the chapel lies, the coffin is lowered and the mourners kneel and pray for a time.

This custom proved disconcerting to the newly assigned priest, who had not been advised of it. One day, while leading a funeral procession to the cemetery, he continued alone along the present trail, while the islanders—obeying the centuries-old prescription—turned off on the ancient path. Filming the funeral with a telephoto lens, I was able to record the cleric's consternation and his frantic chase, vestment hoisted high, across the sand, where he again placed himself at the head of the column. His discomfiture was even greater when, without giving him any notice, the mourners paused and knelt by the coffin, while once more, he alone advanced for about one hundred feet. The islanders told me that they had forgotten to inform him of the custom, but we later learned that other newly appointed and visiting priests had suffered the same fate.

Many practical jokes focus on what folklorists term "superstition" and the Irish call "paganism." The peasants' religion is an amalgam of Catholic Christianity, pagan supernaturalism, and Christian and pagan syncretisms. Since the islanders disavow superstition, it is difficult to know how widely such beliefs are held. The young people deny the existence of other than church-approved spiritual entities, although the most outspoken disclaimer of paganism among them is visited now and again by his father's ghost, who urges the continuation of a family dispute (much to the delight of some members of the "establishment," who, although they are extremely secretive for fear of being ridiculed, nonetheless cling tenaciously to indigenous beliefs). Defensive about being labeled "backward," the islanders feel that the superstitions they are said to hold contribute most to this impression. When the peasants talk of pagan practices, they ascribe them to people of past generations or to certain of their overly superstitious contemporaries.

It is the latter, those who fear

death at the hands of Satan or malevolent pagan beings, who are singled out for practical jokes. In the dead of night their fellows will pound nails, tap windows, and shriek close by, simulating the spiritual omens of impending death—the sound of trooping fairies building a coffin, soft tapping on the bedroom window, and the wailing of the banshee. Those who place most credence in the world of the "little people" are most often the victims of "fairy pranks." If a believer, for example, sets aside his pipe or knife while working in his garden, jokers may steal it and place it on his window sill at home. Or such believers may be pelted from afar with small stones—"fairy darts"—supposedly cast from the sky to do them bodily harm.

A man who collected a number of these darts had them confiscated by the curate in whom he indiscreetly confided; the crestfallen victim never divulged whether the priest did so because he knew that profane pranksters, rather than sacred spirits, were the culprits, or because he believed the darts to have been thrown by irate fairies as "works of the Devil."

Two practical jokes are attributed to my wife and me: one we perpetrated together, but it failed to come off; the other, which I did not perpetrate, worked and is now cited as a premeditated act on my part. Of the more than fifty coastal features on Inis Beag, perhaps the best known is "Piper's Rock," which was named for a local musician, who long ago entered a cave connected by tunnel to a nearby island and who never again emerged on either side. For years afterward, pipe music was heard issuing from beneath the sea off the rock.

One midnight, in an attempt to resurrect the moribund legend, we walked stealthily, crouching behind stone fences, to the rock. There we played, at full volume, recorded pipe music until our fingers were numb with cold. At the pub, less than a half mile away, near-jollification prevailed, and the men had had enough stout to arouse their will to believe. But because of a wind shift, the sound of our boisterous jigs and hornpipes did not carry to them. When word of our unsuccessful nocturnal mission went abroad (how, we never learned), the islanders applauded it, saying it was a shame that such a well-conceived and executed practical joke had gone amiss, even though, had it not, they might have been its victims.

My unpremeditated practical joke occurred one evening during a severe storm when, without advance notice, I visited one of the islanders. He was at the back of the island milking his cow and would not approach me, until I called out to him several times and unmistakably established my identity. As I pondered his reticence, it suddenly occurred to me that many of the peasants believe that the Devil is abroad at all times and sometimes can be seen as a large, dark, indistinct figure standing at a distance, usually at nightfall or when it is raining heavily. Standing atop a fence in my bulky oilskin and pulled-down sou'wester, I had obviously been taken by my friend, one of the least superstitious of the islanders, to be the "big fellow," until I shouted to him. Since I felt guilty about having unwittingly frightened him, I mentioned this extraordinary encounter only to my wife, but somehow it became common knowledge, and behind my back I was pronounced the joker and he the victim.

Like peasants the world over who have suffered centuries of poverty and coercion by outside forces, the people of Inis Beag are ambivalent toward authority. Most hostility is directed against the curate and parish priest, against functionaries of the local and central governments, against the self-appointed "king" of the island (a prosperous publican), and against fathers by their sons.

A vast amount of ridicule, some of it spiced with humor, is directed against the Irish government and its agents. They are derided for the slight differences between the platforms of Fianna Fáil and Fine Gael, the promises made by politicians, which are seldom kept once they achieve office, the inadequacy of subsidies, and the taxation of stout and tobacco. There are no police in Inis Beag, but three are posted on a neighboring island and cross the sound at least once a month. They are subjected to frequent derision when, for example, they come dressed in plain clothes to search for unlicensed dogs and radios or when, having discovered a still on the mainland, they arrest the "poor creatures" who were manufacturing "poteen" (illicit whiskey).

Although jollification prevails on rare "great nights" in the pubs, more often the men solemnly drink their stout.

Police are often referred to as "peelers," a derogatory term assigned to their predecessors, the Royal Irish Constabulary founded by Sir Robert Peel. (Since the English chose his Christian name to immortalize, the Irish naturally chose his surname.)

Anticlericalism is as strong as, or stronger than, antigovernment sentiment and is a significant source of humor. Priests are charged with interfering too much in secular affairs (at times, they forbade visiting, gossiping, singing, dancing, courting, and drinking) and are also accused of living too comfortably, being absent from the island too often, and demanding frequent monetary contributions and services that are rewarded with indulgences rather than pay. (A new dwelling erected for the curate is referred to as "the house indulgences built.") Islanders also accuse curates of conversing among themselves in English while demanding that locals speak only Gaelic. All of these accusations are aired cautiously, through humorous gossip and anecdotes, because of the fear of informers who "gab to our man."

Islanders also hold the priests responsible for having turned wakes into solemn occasions, attended for the purposes of praying for the deceased's soul and sympathizing with his kin. It is hard to imagine wakes more somber than those that take place in Inis Beag, but until recently they were gay affairs, merrier

than weddings, where storytelling, games of various sorts, contests of strength, taunting and mocking, and factional fighting were the order of the night.

Tourists, too, are frequently the target of much humor, although the islanders welcome them as a source of income for shopkeepers, artisans, and those who take in outsiders. Gossip about them continues long after they have left, and during the dull winter months we have heard stories about tourists who would not buy rounds for the locals in the pubs or who bought too many to win "acceptance," who "went native" in attire and behavior to the point of outdoing the islanders, who boasted of their knowledge of little-publicized traditional customs, or who were inappropriate singers, dancers, or storytellers.

The islanders are especially amused by English tourists, who comment on the "quaint and colorful" ways of the people in audible whispers, and by mainland Irish who are boastful of their "Christian Brothers' Irish" (learned "at the school" rather than "from the cradle") and employ it aggressively, and usually incorrectly, at every opportunity.

The islanders, of course, also direct their humor against one another, some of it in the form of nicknames. Each islander is assigned a term of reference, which is never employed as a term of address. For a man, it is a nickname or his Christian name followed by that of his father: Michael the Carpenter or Séan Stephen. Women ordinarily are not given nicknames: if single, their father's first name is

Skillful rowers, the fishermen of Inis Beag often take their canvas-covered coracles far out to sea during the warm months.

appended to their own; if married, their husband's.

If an adult male bears his mother's Christian name following his own, rather than his father's, it usually signifies that his mother unduly dominated her husband. Likewise, if an adult female carries the first name of her father instead of her spouse, it usually means that her husband is overly submissive to her. Such terms of reference must be used with utmost circumspection, given the problems of matricentricity and male identity so common in Inis Beag.

Nicknames usually refer to stature, hair color, occupation, personality idiosyncracies, or events of the past; many are uncomplimentary to the degree of fomenting disputes if uttered at improper times or to inappropriate persons. A man of exaggerated authoritarian manner is nicknamed "General"; a World War I veteran who talks compulsively of his "heroic" exploits in France is known as "Soldier."

The Irish possess one of the oldest and richest oral art traditions in the world, manifested in folklore, literature, and word play. For many decades, folklorists from the European continent and collectors of the Irish Folklore Commission have visited Inis Beag to record prose narratives and other forms of spoken art. Some of the islanders have asked their relatives abroad to send tales of the countries to which they have migrated; these narratives, refashioned to the local milieu, are then sold to gullible collectors as indigenous stories. Local legends are popular: most deal with the famine, evictions, and other excesses of landlords before the 1880s; visits to Inis Beag by the Black and Tans seeking political refugees; and shipwrecks and tragedies among fishermen at sea. These, of course, are rarely humorous.

Sometimes it is difficult to differentiate between local legends and anecdotes and between narratives unique to Inis Beag or Ireland and

Continued on page 114

Ecology of the Intestinal Tract

Inside your intestines, flora colonize specific areas, recognize boundaries, perform supportive services, and stand ready to attack invaders

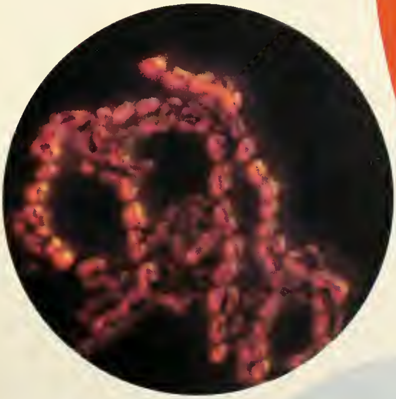
by Gerald T. Keusch

It may be damaging to the ego, but it is nevertheless true that humans carry within their intestinal tracts ten times as many bacterial cells as there are mammalian cells in the entire body. Human cells are thus a distinct numerical minority of the total being that we call man.

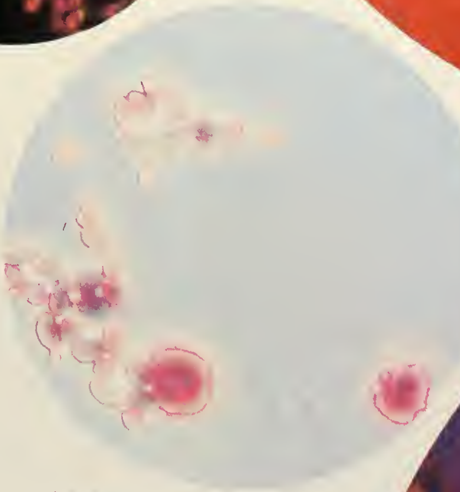
This is not a new discovery. Three centuries ago, Anton van Leeuwenhoek, the Dutch amateur microscopist, observed that "there are more animals living in the scum of the teeth in a man's mouth than there are men in a whole kingdom." Over the past decade the subject of the intestinal bacterial flora has changed: once considered unesthetic and unfashionable, it now has the highest scientific priority. This renaissance has been prompted, in part, by the knowledge that the total number of living bacteria shed daily in the feces of a

Cross section of the small intestine

LENNART NILSSON—FROM "BEHOLD MAN," LITTLE, BROWN AND COMPANY, BOSTON, 1974. © 1974 Albert Bonniers Förlag, Stockholm.



1. JULIUS WEBER

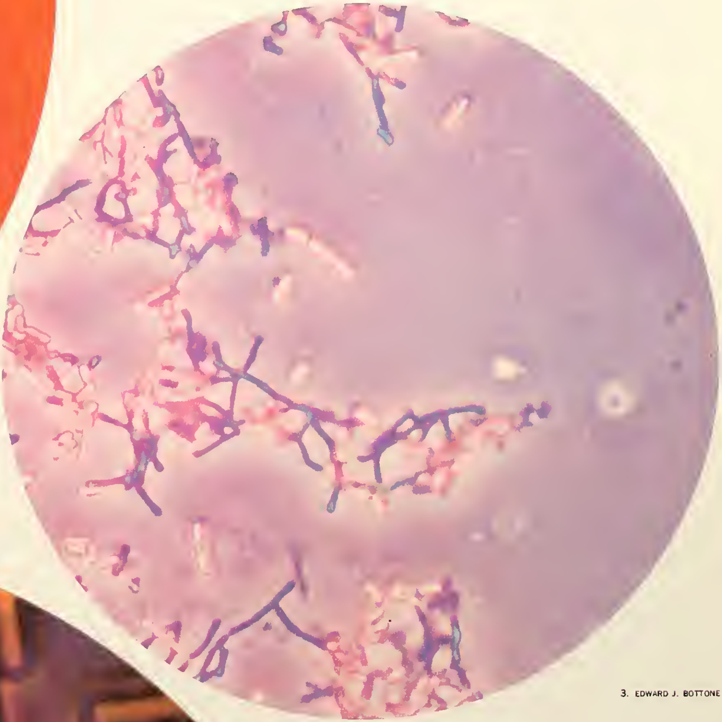


4. EDWARD J. BOTTONE

Diverse Inhabitants of the Intestinal Tract

1. Streptococcus faecalis *(× 4200)*
2. *Section of small intestine (red) showing colonization of* Escherichia coli *in interior cavity (× 3600)*
3. Lactobacillus *(× 1600)*
4. *Budding* Candida albicans *(× 3500)*
5. Clostridium perfringens *(× 7560)*

2. SAMUEL B. FORMAL

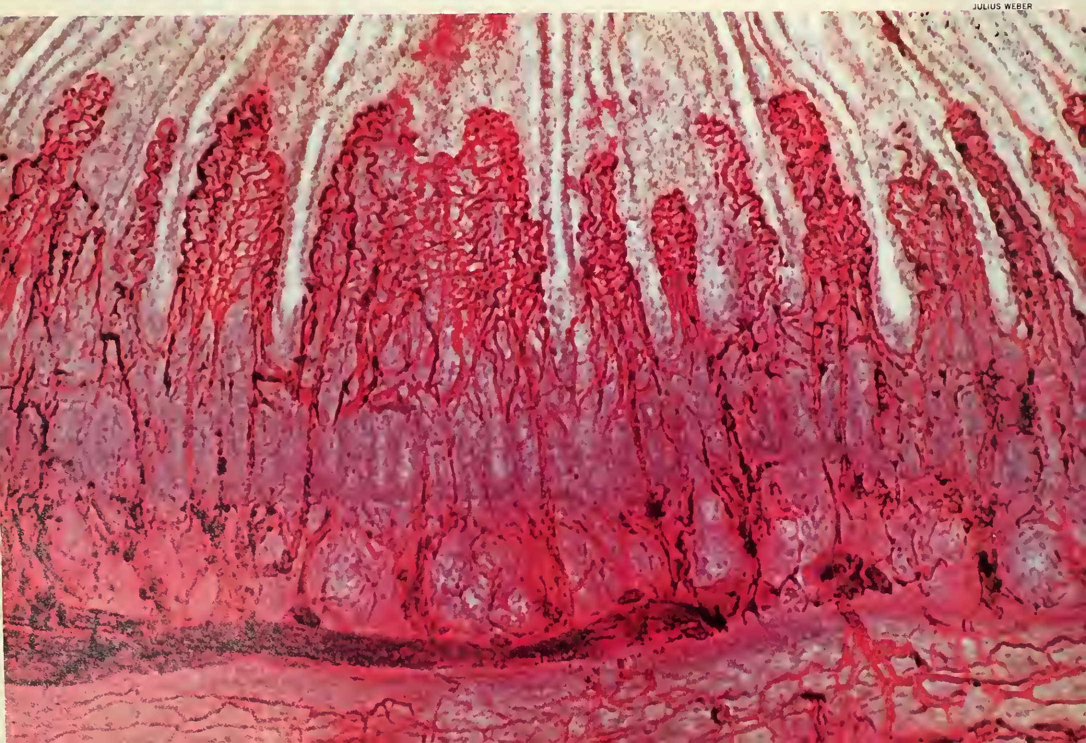


3. EDWARD J. BOTTONE

5. EDWARD J. BOTTONE

LENNART NILSSON

JULIUS WEBER



single person equals or exceeds the 10 trillion cells that make up a human being. In addition, the subject of microecology in the gastrointestinal tract has gained importance as we have begun to comprehend the intimate relationships between the mammalian host and its flora, the physiological effects exerted by the flora, and the role of the flora in health and disease. Thus, we have learned the orderly nature of the derivation and organization of this potpourri of bacterial species. "Nice" people may not talk about their intestinal bacteria, but like Adam, who had 'em, they too are heavily colonized.

The normal intrauterine environment is sterile, and the newborn infant has no bacteria. It is, in the vernacular, germ free. Within hours of birth, however, bacteria begin to invade and colonize the skin and the surfaces of the gastrointestinal tract. Some of these bacterial species, called facultative aerobes, can grow either in the presence or absence of oxygen. Others, however, are unable to survive in the presence of oxygen and hence are called anaerobes. By the third or fourth day of life, the infant has acquired most of the total number of bacteria he will ever have (there will, of course, be some increase as he grows), but it is a curiously monotonous flora. More than 99 percent of the bacteria present in the gastrointestinal tract of the breast-fed infant are members of a single species of anaerobic microorganism, *Bifidobacterium bifidus.* This singular flora appears to regulate the types of bacteria present by restricting the growth of other organisms, including *Bacteroides fragilis*, which is the dominant member of the usual intestinal flora of a healthy formula-fed child or an adult. Significantly, the presence of *B. bifidus* itself seems to protect the infant host against invasion by intestinal pathogens such as the dysentery bacillus.

A vast number of fingerlike projections, called villi, fringe the inner surface of the intestinal wall. By increasing the wall's surface area to about 90 square feet, which is several times greater than the total skin area, the villi facilitate the absorption of food and fluids that pass through the intestine.

Shortly after the infant is weaned from the breast, a richly varied flora becomes established. More than 100 species of anaerobes alone have been isolated from the stool of healthy individuals. Yet the normal flora is not a hectic or random grouping of microorganisms. The majority of these bacteria are concentrated at the two extremes of the alimentary canal, the mouth and the large intestine. The mouth is the gateway to both the intestinal and respiratory tracts, and although it is constantly flushed by a stream of air rushing into and out of the lungs, it contains an ecological niche for a unique and luxuriant flora. It may be surprising to learn that in spite of this rapid flow of air, highly anaerobic conditions prevail in the crevices of the margins of the gum and in the dental plaque that builds up on the surface of the teeth. A remarkable anaerobic flora, perhaps the first human flora ever to be seen, resides in this ecological niche. Large numbers of *Bacteroides*, long slender bacteria with tapered ends known as fusiform bacteria, and spiral coiled organisms are all present in the mouth.

Many other types of microorganisms live in the saliva itself. In addition to the oral bacteria, various species of aerobic organisms (including streptococci, staphylococci, neisseria, and yeast), which colonize the membranes of the throat, may be found in a concentration of perhaps 30 million organisms per ounce of saliva. This is not, however, a large number; in fact, such a solution would appear crystal clear to the naked eye. Physicians have learned that a wound caused by a human bite, and thus contaminated with oral bacteria, is one of the dirtiest of all wounds and requires tremendous attention to prevent or treat infection of the skin and underlying tissue.

The empty stomach contains a small number of organisms, usually fewer than 3,000 per ounce of gastric fluid. The number and variety of organisms increases dramatically, however, during and shortly after a meal. Most of these organisms are ingested with the food or they are oral bacteria that have merely been washed down to the stomach during eating. But the mouth anaerobes generally fail to survive the severe acid conditions in the stomach and are rapidly killed. The survivors, normal residents of the stomach, are acid-resistant species, such as streptococci and lactobacilli.

An acid-resistant flora in relatively small numbers similarly resides in the upper small intestine. After meals, small numbers of fecal organisms may be present, but these are considered transients, bacteria that are "just passing through." The size of the bacterial population increases as one proceeds along the small bowel. The last portion of the small intestine, called the ileum, contains 25 to 50 million organisms per ounce of fluid. The major species are facultative aerobic organisms, including *Escherichia coli*, streptococci, and smaller numbers of *Bacteroides*, *Bifidobacterium*, and *Clostridia.*

This is merely a hint of what is to be found just the other side of the ileocecal valve, the junction of the small and large bowels. On the large bowel side of the valve there is a sudden, massive increase in the total number of organisms. In excess of a billion organisms per gram, predominantly anaerobic bacteria, can be found here. The facultative flora, however, is suddenly reduced to less than 1 percent of the population since conditions in the large intestine are particularly conducive to the propagation of anaerobic organisms: the low oxygen concentration and the small number of aerobes, using up what oxygen there is, make it possible for the anaerobes to thrive.

At the usual concentration of bacteria in feces, approximately 20 percent of the stool mass is a solid aggregate of live bacteria. Interestingly, the previous concept of this huge mass of bacteria was that the majority of organisms were nonviable. This view undoubtedly was a consequence of the lack of suitable anaerobic techniques for cultivation of the many strictly anaerobic microorganisms present. Contemporary methodology allows investigators to grow nearly all of the organisms that can be seen by direct microscopic examination. In fact, the number of bacterial species that can be found actually depends upon the diligence of the bacteriologist. With a bacterial population in excess of 100 billion per gram of stool, organisms present in concentrations of only 10 million per gram would, on the basis of random chance, be isolated only once in 10,000 times. In other words, one might have to study 10,000 randomly isolated colonies from the intestinal contents to find a single cell of the species under consideration.

Since this is a difficult task (it would take about a year to complete), microbiologists have developed a variety of different growth media that selectively and predictably restrict growth to certain members of the microflora. By using a combination of these selective media, it is possible to isolate and quantitate some of the bacterial species that are present in relatively small numbers.

Nature ordinarily operates with some reason to her rhyme. The constant interaction under the most intimate conditions of so many bacteria with their human host, while not obvious to the uninitiated observer, affords a mutually beneficial relationship for both man and microbe. Unfortunately, it is not so simple to document these symbiotic or beneficial interactions. Nor is it easy to order and control them for the promotion of health.

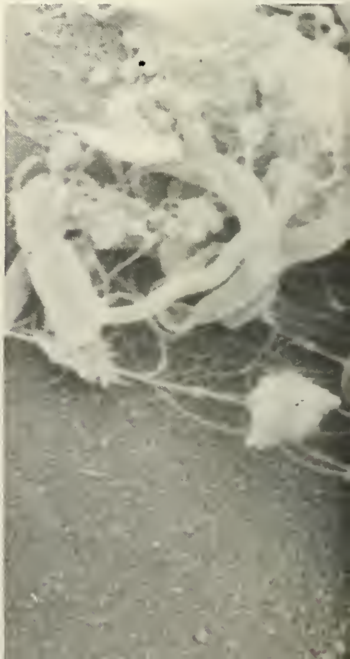
These different species of microorganisms do not occur randomly or chaotically along the length of the gastrointestinal tract. In fact, they are arranged in an orderly fashion. By performing Caesarean sections on laboratory animals and then raising the young under antiseptic conditions, where even the food is sterilized, experimenters have been able to produce germ-free animals. If we were to take a germ-free mouse and feed it *Lactobacillus*, which normally attaches to the nonacid-secreting cells of the stomach, the *Lactobacillus* would go only to that area of the experimental animal; it would not colonize the entire intestinal tract, even though there would be no competing bacteria.

Not only do the gastrointestinal flora colonize specific areas, but if they are able to establish growth in places where they are normally excluded, as sometimes happens after specialized surgical procedures or if there is a structural deformity in the intestinal tract, they produce illness in the host. In these areas of the body, bacteria may compete with the cells of the intestinal lining for available nutrients, such as vitamin B_{12} or carbohydrates. This in turn can result in deficient absorption of these nutrients for normal host metabolism. These microorganisms are actually no different from those present in even higher concentration in the large bowel. In their abnormal habitat, however, they can cause malabsorption or interfere with fat absorption.

In some instances organisms colonizing abnormal sites may synthesize specific proteins or they may alter dietary foodstuffs to produce metabolic products that cause the intestinal mucosal cells to secrete fluids into the intestinal tract. When the volume secreted exceeds the capacity of the remainder of the intestinal tract to absorb water, the result is increased volume and frequency of discharges from the bowels, or diarrhea. Such diarrhea-inducing proteins made by bacteria are called enterotoxins. Other bacteria, when colonizing an abnormal habitat, may produce certain fatty acids, such as ricinoleic acid, which is biologically similar to castor oil and produces the same well-known cathartic effect.

Certain bacteria, which must interact with each other, cohabit the same area, performing, as it were, supportive services. Some species, for example, cannot synthesize amino acids, some of the B vitamins, or vitamin K, but needing these nutrients for growth, they live in a colony with bacteria that can provide them. In some cases, one group of microorganisms produces the energy sources—sugars, for example—for the growth of another.

The gastrointestinal flora also interact with their immediate surroundings, the epithelial cells of the host. Both the gross and microscopic structure of the small bowel and cecum are affected by the presence of bacterial flora. In the germ-free state, the small bowel mucosa is thinner, more regular, and has fewer scavenger white blood cells. Similarly, the structure of the cecum is markedly different in the germ-free animal, but if we introduce a defined bacterial flora, it can be rapidly altered to the "normal" state, in this case, conditions



Magnified about 10,000 times with a scanning electron microscope, various microorganisms are shown in their habitat—the outer border of the cells of the villi in a rat's small intestine.

STANLEY L. ERLANDSEN

found in the presence of bacteria. The gastrointestinal flora also affects the turnover of cells in the intestinal mucosa. In the presence of bacteria, intestinal epithelial cell production and migration are far more rapid—in fact about twice as fast as in a germ-free animal.

Interacting with each other and with the epithelial cells of its host, the gastrointestinal flora is, of course, also affected by the host's larger environment. This intimate relationship is most apparent in the cases of diet and disease. Bacteria can metabolize components of the normal diet to products with important physiological effects. Grazing animals, for example, have cellulolytic bacteria that enable them to break down cellulose. In humans, bacteria may also play a role in converting therapeutic drugs to an active form.

Some geographic patterns of disease may be explicable on the basis of differences in the bacterial flora. Residents or temporary residents of tropical countries may develop abnormalities of the structure of the intestinal lining. These are accompanied by functional abnormalities, such as maldigestion of milk sugar and malabsorption of some carbohydrates and vitamins.

The gastrointestinal ecosystem is also self-regulatory. Maintaining a constant defense against "outsiders," members of the normal flora produce short-chain fatty acids that inhibit the growth of invading pathogens. Certain bacteria produce substances, collectively called bacteriocins, that, like orally administered antibiotics, kill off other bacteria. The production of hydrochloric acid by the gastric mucosa, the rapid propulsive motility of the small bowel, and the production by the intestines of antibacterial proteins and enzymes, which can digest the cell wall of certain bacterial species, may also play roles in protecting the system's status quo.

In fact, it is rather difficult for invading strains to colonize. Since they are at a metabolic disadvantage vis-à-vis the established flora, they require a certain amount of intrinsic or extrinsic aid. If, for example, an individual is taking antibiotics therapeutically, the medication may also remove a portion of the established normal flora, allowing a newly invading strain to readily colonize. This is particularly true if the invader is resistant to the drug. Sometimes new strains are able to colonize because they can utilize a substrate that is not being used by the long-term resident flora.

By studying the gastrointestinal system when it has "broken down," when its microfloral balance is askew, investigators are able to learn a great deal about its normal ecology and functioning. They are provided with this opportunity each year when thousands of tourists return home suffering an acute intestinal affliction known variously as Montezuma's revenge or Delhi belly. This disease, perhaps most appropriately called traveler's diarrhea, is one in which foreign visitors to developing or tropical countries experience moderate to severe diarrhea. In these cases, the illness is not caused by recognizable pathogens, such as *Shigella* or *Salmonella*, protozoans like *Giardia*, or amoebae, all of which can also be at fault.

In some individuals, however, onset of travel-related diarrhea occurs only after the return home, when another change of exposure to environmental influences occurs. Under these circumstances, it is at least as likely that bacteria encountered after return are responsible for the symptoms as it is that bacteria acquired abroad are the culprits. Thus, "Bronx belly" or "Rockefeller's revenge" could easily be used as synonyms for the condition. When the stools are cultured in the clinical laboratory, investigators seek only the aerobic organisms, and the usual result is recovery of *E. coli*, either predominantly or exclusively. Since this is a normal finding for healthy people, little significance can be attached to it. In fact, the procedures are geared toward detection of shigellae, salmonellae, and salmonellalike bacteria, so that other possible pathogens can easily be overlooked.

The problem became better focused after an outbreak of diarrheal disease in British soldiers in Aden was traced to a single strain of *E. coli*. Although all *E. coli* look alike and behave similarly when cultured in the laboratory, they are not identical. The outermost structure of the organism is a fairly rigid cell wall that provides stability. The superficial layer of this wall is composed of polymeric sugars, or polysaccharides, arranged in a specific fashion.

The arrangement of these polysaccharides, which is under genetic control, differs from one strain of *E. coli* to another and serves as an identifying marker, much like a fingerprint. These sugars can stimulate production of specific antibodies, which can be used, in turn, for recognizing all organisms bearing that particular arrangement of sugars. Such a system of serotyping (classification on the basis of antiserum, or serological, reaction) has been developed for *E. coli*, and it was this feature that allowed the typing of the Aden strain.

For many years it has been known that certain serotypes of *E. coli* can cause diarrheal disease. These infections have generally occurred in epidemics, particularly in hospital nurseries. The clinical illness has not been restricted to diarrhea, however; bloodstream infection and meningitis have also been a part of the problem, sometimes accompanied by high mortality rates. These serotypes have been grouped together as the "enteropathogenic *E. coli*," although adults and older children can carry these strains without disease. In fact, aside from epidemic situations in closed newborn populations, little correlation could be made between serotype and symptoms.

At about the same time as the Aden outbreak, Sherwood Gorbach and his colleagues from Johns Hopkins University, working in India, began to isolate large numbers of *E. coli* of the same serotype as the Aden strain from adults with severe choleralike disease. But the organisms were present in an abnormal location, in the small bowel, and it could be shown that the diarrhea fluid was originating in that very segment of intestine. Upon further investigation, it became evident that these particular strains of *E. coli* produced an enterotoxin that stimulated the small bowel to produce fluid in such profuse amounts that it exceeded the absorptive capacity of the rest of the tract. The toxin did not affect the large bowel, thus explaining why mere isolation of a toxin-producing strain from stool might not indicate the cause of disease unless it were also present in the small bowel. The capacity for toxin synthesis, which is under the genetic control of a transferable bit of extrachromosomal DNA called an episome, is totally distinct from the synthesis of sugar polymers determining serotype, which is genetically controlled by chromosomal nucleic acids. Not surprisingly, further investigations have validated enterotoxigenicity as the mechanism for disease production totally independent of serotype.

Since serotype does not serve to identify the virulent strains, there has been no feasible way to investigate possible *E. coli* agents of traveler's diarrhea. Very recently, however, Andrew Dean of the Harvard School of Public Health has proposed a screening test involving inoculation of suckling mice. Positive results in this system, which allows screening large numbers of isolates from adults, correlate well with toxigenicity determined by more exacting methods. In the mouse test, investigators inoculate a live culture of the strain to be evaluated into the stomach of a one- to four-day-old suckling mouse. After four hours, they look for excess fluid in the intestinal tract.

This method was used for a study of twenty-eight Harvard University personnel traveling to developing countries. To study serotype shifts (changes in the predominant type of *E. coli*) and the presence or acquisition of toxigenic strains, investigators obtained cultures before travel, at the onset of diarrhea, one week before return, and after the subjects arrived home. Nearly 40 percent of the subjects experienced traveler's diarrhea. All subjects remaining healthy were free of toxigenic strains before, during, and after travel. In contrast, more than a third of those who became ill acquired a toxigenic *E. coli* with a new and unique serotype during their trip. None of these strains were among the enteropathogenic serotypes. This remarkable result, if confirmed, would clearly indicate that toxin-producing *E. coli*, newly acquired through food, water, soil, or poor sanitation, are a major cause of traveler's diarrhea.

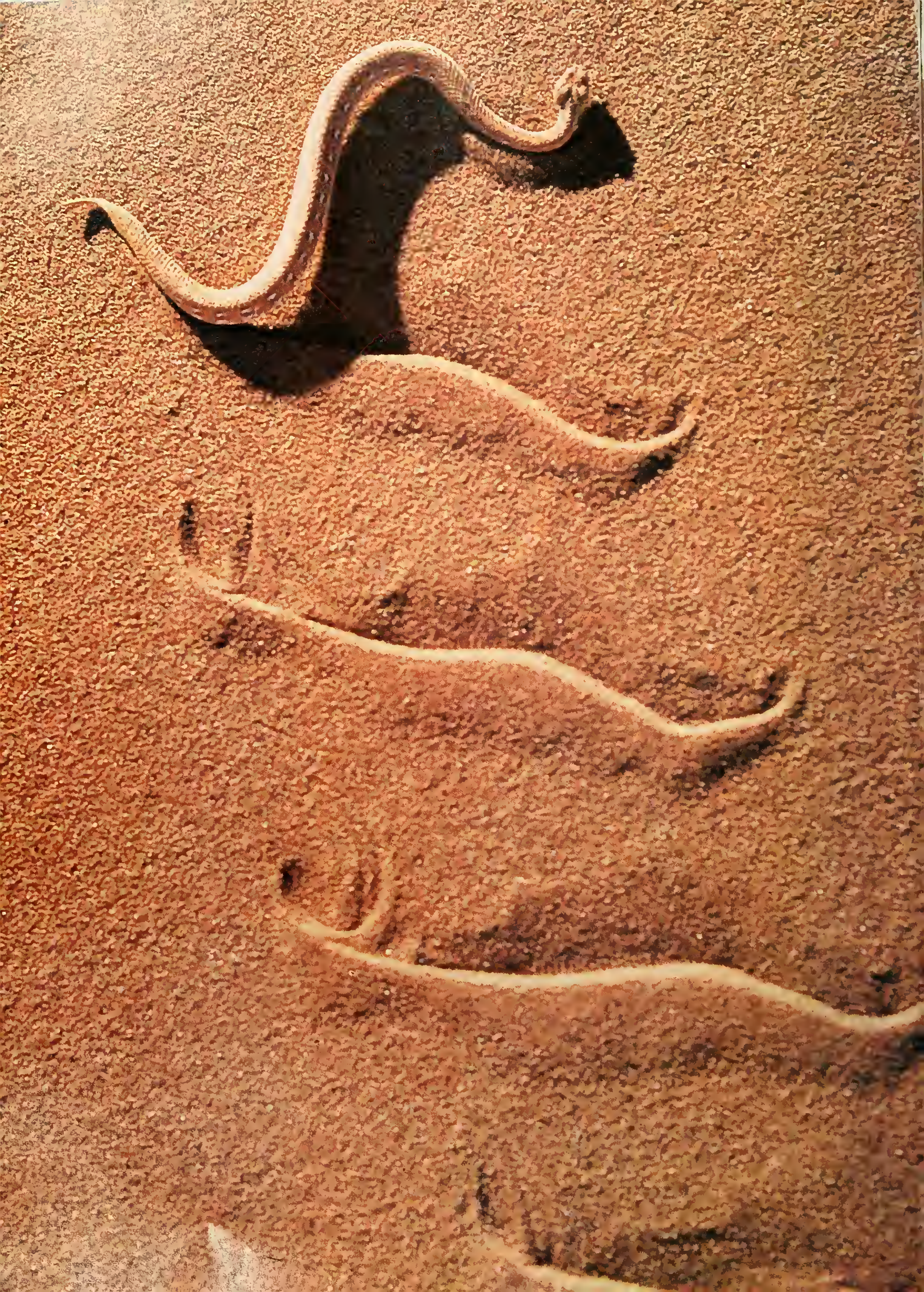
Some of the pathogenic organisms that cause gastroenteritis (and other types of illness that start in the intestine) are widely distributed in nature. There are, for example, more than 1,600 different *Salmonella* species. Inhabiting turtles, birds (including chickens and turkeys), and all mammals (such as cattle, pigs, and sheep), these species are frequently introduced into the human environment, either as part of the diet or through contact with pets (as in the case of turtles) and thus are ubiquitous sources of infection.

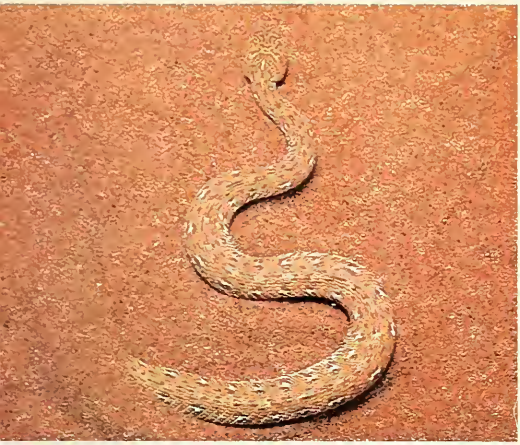
A network of vessels in the intestinal wall brings in oxygenated blood and takes out nutrient-rich blood for circulation through the body.

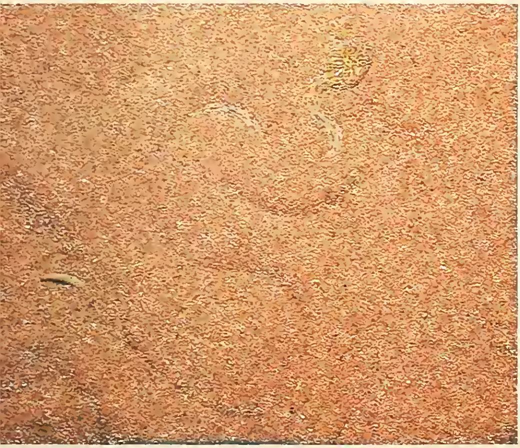
Other organisms, however, such as shigellae, do not infect or reside in animals other than humans. Over the millennia, these organisms could not have survived without person-to-person transmission taking place since there is no other reservoir for them. Because the normal human flora is antagonistic to the growth of shigellae, the diarrhea they cause can be considered, from a teleological point of view, a necessary device to procure continued life for the organism. If the bacteria were to kill its host without providing some means of infecting other individuals, it would be writing the death warrant for its own species as well. Thus, although it takes only a few hundred bacteria to cause infection in many individuals, the microbes must travel constantly between people. To the distressed victim, however, it is probably of small comfort to know that his agonies are part of the life cycle of the tormenting organism.

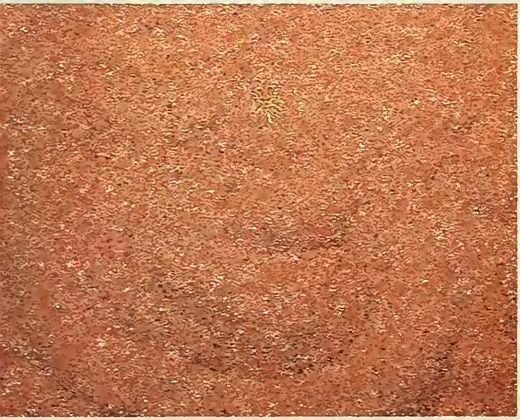
Through efforts to understand the microecology of the intestinal tract and the overt and subtle interactions—both beneficial and harmful—between host and flora, ultimate control of disease and promulgation of health will come. It is to this end that a generation of scientists are delving into a most complex and seemingly limitless ecosystem. □

LENNART NILSSON









Desert Adaptation

The Namib Desert along the southwest coast of southern Africa, where cold Antarctic Ocean currents create a steady thermal inversion, is one of the driest regions on earth. One of the oldest deserts, the Namib probably formed soon after the Antarctic land masses separated. All forms of life there have adapted to the harsh climate and sand-duned terrain.

For rapid locomotion across the sand, particularly when fleeing a predator, the desert side-winding adder, *Bitis peringueyi,* first digs the lower edge of its body into the sand; then rolls the rest of its body forward with a concertina-type motion (opposite page).

Many snakes in sandy habitats around the world adopt this side-winding movement. It is an efficient form of locomotion; some snakes have been observed to travel a mile at high speed.

A second adaptive tactic, a form of burrowing, enables the snake to hide from predators and still watch for its own prey. The adder undulates and twists its body so that it sinks into the sand (top to bottom), except for the top of its well-camouflaged head (bottom). The sand also protects the adder from the desiccating rays of the sun.

A typical snake has 100 or more trunk vertebrae, each with two ribs, with which to perform such complex motions. On each side of a vertebra, a snake may have as many as 20 discrete muscles, connecting vertebra to vertebra, vertebra to rib, rib to rib, and both rib and vertebra to the skin.

Photographs by Anthony Bannister

Realm of the Rice Eater

Where these small grains are the meal, varieties of taste and texture matter greatly

"She's never wrecked the rice," boasts the proud husband on a current television commercial. How should we react to this uxorious confidence? Shudder at the thought of all those other meals botched by a wife whose highest culinary attainment is a successful bowl of plain rice? Conclude that hubby is damning with faint praise?

Both interpretations are reasonable, but they overlook the reason for the ad, which is that most Americans don't much like rice and don't understand it. Perhaps I should say that Americans north of the Mason-Dixon line are flummoxed by the little white grains. In the South, people have grown up with rice as a familiar staple, in jambalaya, with red beans. But in the populous North, rice sits in a far corner of the cupboard. We eat it sometimes, but it is still tinged with the exotic. Rice is within our reach, but not quite within our grasp.

If you doubt this, answer the following questions without consulting a recipe. How much raw rice will serve six people under normal circumstances? Must it be washed? How much water is necessary for cooking one cup of rice? How long should it be cooked?

Now quiz yourself about baked or mashed potatoes. Confidence returns, does it not? You are back on your own ethnoculinary turf. For the majority of human beings, however, the situation is reversed. A fluffy mound of the seeds of *Oryza sativa* is the stuff of life.

On Bali, rice is so important that every stage of its cultivation has inspired ritual and awe. By Balinese tradition, rice has a soul and is addressed as if it were human—as "mother," "grandmother," or "grandfather." Rice, in short, is part of the family and can be spoken to as a relative.

On nearby Java, a symbolic marriage of rice grains is held, and the happy couple sent on a symbolic honeymoon with the wish that they come back as four instead of two. This is the mirror image of the Western tradition of throwing rice at a real couple to wish them happiness and fecundity. I am unable to find a satisfactory explanation for this rare appearance of rice in our folklore. Could the custom have developed in, and migrated to us from, a more rice-prone part of Christendom?

In any case, mixed Christian and animistic rice rituals have been recorded in several places. At San Isidro, the Philippines, rice planters exhort their seedlings with this combination of old-time moon worship, biblical allusion, and a nod to their modern patron saint:

Look upward to the moon above;
Be swayed by seasons' smile
and sob;
For thou wert by Pharoah sold;
Seeds of San Isidro of old.

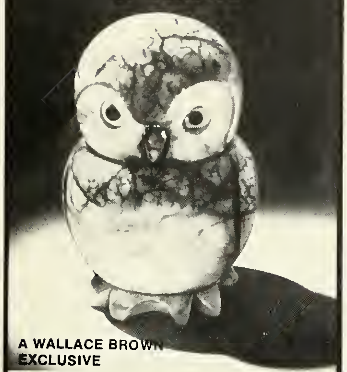
Pharaoh's grain sale (Genesis, chapter 47) kept Joseph's brethren alive during a famine. Eventually, as everyone knows, the Hebrews fled Egypt so quickly that they had no time to let bread rise and ate unleavened bread. This is now commemorated during the Jewish religious holiday of the Passover, when orthodox households consume only specially prepared, flat matzoh. And, to insure that there is not the slightest remnant of leavened bread in the house, Jews go on a symbolic hunt for bread crumbs and burn those they find. I mention this because European rabbis expanded the scope of this bread hunt to include certain other starchy substances, which they considered close enough to bread to merit proscription for Passover. Rice is one of these forbidden foods, but only in the homes of Jews following the traditions of the European rabbinate. Jews who never left the Middle East (or who follow the Passover traditions practiced there), eat rice throughout the holiday. For them, there was no risk of confusing their staple grain with remnants of leavened bread. Jews in northern Europe were too far from the rice belt, presumably, to convince their local Talmudists that they wouldn't make a mistake between imported rice and domestic crumbs.

If this seems an overly scrupulous prohibition, it is at least an attempt to reckon with the extremely low level of knowledge about rice in an area where other cereals predominate. Consider for a moment the mushy wads that result when most Americans dabble in rice, and you may decide that the rabbis did not go far enough; that rice should be under perpetual taboo in northern climes.

Short of initiating a full-scale rice interdict, we could attempt to solve the rice pudding problem by copying, to some extent, the rice connoisseurship of, say, central Madagascar, where no fewer than seventy varieties of rice are known, each by its own name. Or we might expand our rice consciousness by contemplating the esthetic gradations of taste available to a rice shopper on Leyte Island in the Philippines: sixty-seven species ranging from Kabo-ong (round, red grain) to Kalumot (sweet odor, white grain).

With such an array of rices to choose from, it is not mere ethnocentrism for a Malagasy to say: "We do not eat the foreigners' bread even when we can afford it, for it does not fill us up." Nor is it just a cultural paradox that, according to Jane Richardson Hanks, who did field work in the Thai village of Bang Chan, " 'famine' in this abundant land consists in going

Save $2.00 on my beloved be polished Alabaster Owl cf Volterra



A WALLACE BROWN EXCLUSIVE

Was $7.95—now only $5.95

Thank my wife for this, you polished owl lovers. With the dollar buying more abroad, and the quarries of Volterra in Italy selling at a nice price, my wife says, "Wallace—you must pass the savings on, and sell that owl for less—so that more people can give it as a present and own it themselves."

Never argue with your wife.

If more people can enjoy the elegance of this wondrous sculptured owl from Italy at $2.00 less—I'm for it. Means more people can use it as a hefty paperweight. More owl collectors (and just wise people) can get it as a gift. Stands 4" high—weighs more than a pound—in heavily marbled pearl gray with black and yellow deep-set eyes. Polished by hand. From the Alabaster quarries of Volterra, which are a little north of Pisa, Italy. All your money back if not enchanted. That's about a 25% savings—from $7.95 to only $5.95.

Wallace Brown
SINCE 1922
5121FRI
Westmoreland Avenue, White Plains, N.Y. 10606

MAIL NO-RISK COUPON TODAY

WALLACE BROWN, DEPT. AVX-27
Westmoreland Ave., White Plains, N.Y. 10606

Please send me the following Alabaster Owl(s) with full money-back guarantee if I am not delighted.

☐ One for $5.95 ☐ Two for $10.95

Add 75¢ postage and handling for each. New York State residents please add appropriate sales tax

Enclosed is ☐ Check for $____
☐ Money Order for $____
or charge my ☐ Master Charge
☐ BankAmericard ☐ American Express

Card Number____
Master Charge Bank #____
Signature____
Name (print)____
Address____ Apt
City____
State____ Zip____

DIVISION OF BEVIS INDUSTRIES, INC.

without rice, even when fish and vegetables abound."

Unfortunately, many rice cultures today do not abound in their favored staple. It is said to be easier to buy India's celebrated long-grained, perfumed, and aged basmati rice in New York than it is in New Delhi. Basmati was always a delicacy, but even humbler varieties are now beyond the grasp of hungry millions in India and Bangladesh, who would normally consume between one-half and two-thirds of a pound of rice per day. Americans, who eat only about six pounds of rice per year (much of it precooked and tasteless), find it hard to understand why starving Indians will not readily accept donations of soy flour. A similar blindness to local tastes has impeded the acceptance of new, high-yield varieties of rice in the Third World. Rice eaters detect crucial differences between strains of rice, and they care deeply about such "refinements," deeply enough to hold out for what they like. This may seem desperately illogical. No doubt it is, but no one will any longer dispute the importance of taste connoisseurship at all levels of society. "Caviar to the general" is what it eats every day and has eaten since childhood. Only a few sophisticates break away from the folk diet; the majority in any culture remain gourmets of the ordinary.

This is a general problem that all societies increasingly face as shortages force nutritional planners to consider alternative sources of food that are repugnant to the average eater. Perhaps "advanced" cultures that have already accustomed themselves to a varied and synthetic diet ranging from nondairy "cream" to soy-filled meat will adjust more easily. What, though, is to become of a place such as Bang Chan, where locally grown rice is at once the main work of the town and the source of symbolic order in the life of women who monopolize its production, its rituals, and its preparation. More concretely, in Bang Chan, as in many other rice cultures, rice is not just part of the meal. It *is* the meal, with fish and vegetables added more or less as condiments.

In the short term, there is probably nothing anyone can do to forestall mass starvation in some rice-dependent areas. But the very least we can do is to take a symbolic

NATURAL HISTORY FILE

only $4.95 each

Holds a year's subscription - keeps all copies neat, clean and in one place.

A deluxe Royal Blue magazine case with "Natural History" gold stamped on the face. Has the expensive good looks of a leather-bound book. Organizes your valuable collection by year of issue. Reduces clutter in your home or office, keeps copies handy for easy reference. Sturdy bookbinder's board protects copies against soil and damage for as long as you want to keep them. Gold leaf furnished free for dating, etc. Send check or money order. Money refunded if not satisfied.

Natural History File .... $4.95 ea.; 3 for $11.95 postpaid

We have custom designed files for over 8,000 magazines. Order by title, $4.95 ea. ppd.

SHANNON CORPORATION Dept. 114N
734 N. Decatur Ave., Minneapolis, MN. 55427

ENJOYMENT FOR ALL

Attract hummers with a Brown's Original "Hummy-Bird Bar"®. A favorite for 19 years. Durable and long-lasting. Watch them sip from this 4-way see-thru feeder cup. Glass bottle; detachable perch; beeproof; no drip or rust. Guaranteed. Instruction. $3.50 plus 50¢ hndling & pstge ea. Add 21¢ tax in Calif. No CODs. HUMMINGBIRD HEAVEN, 10726-N Samoa Ave., Tujunga, CA 91042. Made in U.S.A.

EXCEPTIONAL 5-ACRE RANCH. Lake Conchas, New Mexico. Only $995 per acre. Vacation Paradise. Good long term investment. Easy Terms. Free brochure. Ranchos, Box 2003NH, Alameda, California 94501

Early American Antiques

New monthly magazine which features great American houses, unique collections of Americana, where to go Antiquing, how to identify and care for antiques, lists of shows, directories of craftsmen, reports on shows & sales. $8. per year. Send 75¢ for sample copy.
Dept. 224, New Hope, Pa. 18938

stand and cook the rice we do cook with reverence, taking care that each precious grain swells to its fullest but stays firm and separate from the rest. Perhaps we could even inaugurate our own rice ritual: a moment of silence for those who are not getting enough of the seed that they love almost more than life.

The recipe below is tailored to Western rice tastes. Asians, whose national preferences run the gamut from sticky to dry rice, would have other ideas and other strains of rice to achieve them with. In this country, long-grain Carolina rice is the grain to buy to produce the slightly chewy, *al dente* texture admired by most people who have thus far declared themselves on the subject in the English language. If you want mushier rice, use more liquid.

Rice Pilaf with Mushrooms and Sausages

12 tablespoons (1½ sticks) butter
1 medium onion, chopped
1½ cups unwashed raw rice
3¾ cups (30 ounces) chicken stock
2 canned Italian tomatoes, seeded and chopped
15 small mushroom caps sautéed in 1 tablespoon butter until tender
15 small link sausages pricked with a fork and sautéed in 1 tablespoon butter until solidified and crusty

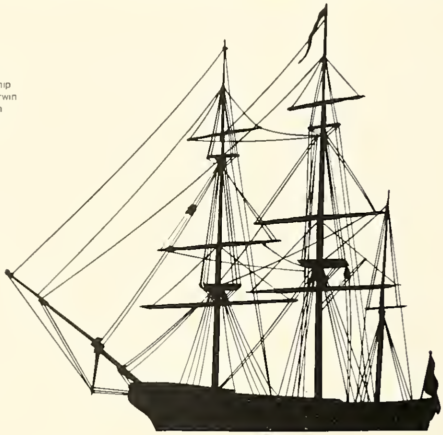
1. Melt the butter in a large, heavy-bottomed saucepan, add the onion and stew until softened. Add rice and stir over medium-high heat until rice turns a milky color. Add chicken stock and bring to a boil. Cover, reduce heat, and cook for nine minutes.
2. Stir in tomato and sautéed mushroom caps and sausages. Cover again and continue cooking over low heat for nine more minutes or until rice is cooked through but still firm. Let the pilaf sit, off heat but covered, until any remaining liquid is absorbed. If kept covered, the finished pilaf will stay hot enough to serve for twenty to thirty minutes. It can also be held in a warming oven for two hours. The butter keeps the grains apart.

Yield: 6 servings

Raymond Sokolov is a food columnist and editor of Great Recipes from The New York Times.

Follow in Darwin's Wake

For Museum members, cruising from Tierra del Fuego to Buenos Aires can be a memorable vacation and a chance to see and learn what inspired one of mankind's "great leaps forward."



H.M.S. Beagle, the ship that took Charles Darwin to a new view of man and his origins.

Darwin sailed to Tierra del Fuego and the east coast of South America to see and study the wildlife. Now, we're going to take 85 Museum members to retrace his route, cruising on the celebrated M.S. Lindblad Explorer. Along the way, Dr. Junius B. Bird, Curator Emeritus of Anthropology, will outline the prehistory of the area and take us to some of the sites he has explored for The American Museum. Dr. Roger Payne will also accompany us to make sure we see and understand the fascinating marine life, as will ornithologist Maurice Rumboll of the Argentine Museum of Natural History, explorer and writer Eric Shipton, the former head of the Charles Darwin Foundation, Dr. Roger Perry, and botanist Natalie Goodall. Logistics are under the supervision of the well-known travel planner Lars Eric Lindblad; the program is the Museum's. Prices start at $2400 per person, plus airfare and a contribution to the Museum.

Scheduled for February 17–March 10, 1975, this is the first voyage in the Museum's Membership Tour Program for 1975. We have also tentatively planned an expedition to southern Africa for September 1975, and a third trip will soon be announced.

Mail the coupon below for further details.

Mrs. Philip Martin
Tours for Members
The American Museum of Natural History
Central Park West at 79th Street
New York, New York 10024

Please send:
☐ The Darwin Itinerary ☐ Information about other Museum-sponsored trips in 1975.

Name ______________________________

Address ______________________________

City ______________________ ZIP __________

DRAMATIC DINOSAUR MURAL 9 FEET LONG -- IN FULL COLOR!

Rudolph F. Zallinger's Pulitzer Prize-winning "Age of Reptiles" mural in the Peabody Museum of Natural History at Yale University can now be a major exhibit in school and libraries, or a spectacular home decoration.

Faithfully reproduced on 9' x 1½' durable plasticized paper, in full color, this fascinating "sweep through time" blends together a continuous image of life during the age of reptiles. The original, authenticated by experts, took 4½ years to complete.

An accompanying 40-page teaching guide describes the plants and animals, and includes a fold-out keyed illustration. $28, postpaid.

Peabody Museum, Dept. NH
Yale University, New Haven, Conn. 06520.

Détente in Space

Americans and Russians will cooperate for the first time on a join

The Space Age began with startling effect on October 4, 1957, when the Soviet Union successfully orbited Sputnik I, the first artificial earth satellite. Few who lived through that momentous event will forget its massive political, emotional, and psychological impact. In the United States it created a sense of urgency, a concern that led to far-reaching demands for the reorganization and redirection of the educational system. The American public began to emphasize science and technology as never before and spent vast sums of money for both civilian and military technological research and development.

Intense international competition characterized the early years of the Space Age. Space achievements were viewed as an index of a nation's scientific, military, and even cultural strength. The programs of both the Soviet Union and the United States were dedicated to being first to land men on the moon. But with Neil Armstrong's "giant leap for mankind" in 1969, the competitive aspects of space exploration began to subside. Today a spirit of cooperation prevails. This spirit is perhaps best symbolized by plans for a joint, manned earth orbital mission by the former space rivals, the United States and the Soviet Union. Known as the Apollo-Soyuz Test Project, the mission is scheduled for launch on July 15, 1975. Its primary goal, according to Chester M. Lee, the American program director of the joint project, is "to test technical solutions for creating compatible docking systems, which can be used internationally for docking future manned spacecraft and stations." The mission will also carry a complement of scientific experiments, but it was recognized from the outset that scientific objectives would be secondary. The design and manufacture of a compatible docking system will not only provide a framework for future cooperative programs in which scientific experiments could play a larger role but will also make possible the rescue in space by either country of a disabled craft belonging to the other.

The mission is expected to proceed as follows. First, the Soyuz spacecraft, carrying two cosmonauts, will be launched from the Baikonur site in the Soviet Union into an orbit measuring 101 by 123 nautical miles. To prepare for docking with Apollo, the cosmonauts will maneuver their spacecraft into a circular orbit inclined at an angle of 51.6° to the Equator and about 121 nautical miles above the earth.

The first opportunity for a compatible Apollo launch will occur about seven and a half hours after the Soyuz lift-off. There are four additional opportunities, or launch windows, spaced about twenty-four hours apart, each lasting about fifteen minutes. A Saturn I B vehicle, launched from Cape Canaveral, will put the Apollo spacecraft into an orbit measuring 81 by 90 nautical miles. Then, in a maneuver similar to that used on Apollo lunar missions, the three astronauts aboard will separate the command and service modules from the Saturn IV B stage, turn around, and unite with the universal docking module, which will also have been carried into space by the Saturn launch vehicle. Apollo will then rendezvous with Soyuz. The two spacecraft will dock about twenty-four hours after the Apollo launch.

In addition to conducting scientific and technological activities, the astronauts and cosmonauts may exchange visits several times while their spacecraft are joined in earth orbit. Throughout the mission, however, at least one cosmonaut will stay with Soyuz and one astronaut with Apollo. The crews will be able to converse in either Russian or English during their various social calls, since proficiency in each other's language has been added to the already strenuous training for astronauts and cosmonauts.

by Michael B. McElroy

anned earth orbital mission in the summer of 1975

The linkup is presently scheduled to last for two days. The Soyuz flight has a maximum duration of six days, while the Apollo flight, with a maximum lifetime of twelve days, can continue for several days after separation from Soyuz, during which time many of the on-board experiments will be carried out. At the end of its mission, the Soyuz craft will land somewhere in central Russia. The Apollo spacecraft will come down in the Pacific and be recovered by the U.S. Navy, as in previous Apollo flights.

The first tentative plans for the joint space mission were formulated at a meeting of senior NASA officials with representatives of the Soviet Academy of Sciences in Moscow in October, 1970. The meeting was part of a more extensive exchange intended to identify potential areas for increased cooperation between the Soviet Union and the United States in the peaceful exploration of space. The talks should, however, be viewed in a broader context. Former President Nixon had become committed to a foreign policy designed to hasten the end of the Cold War. Cooperation in space, requiring close personal contact between scientists and technologists of both countries and thereby fostering an attitude of mutual trust and confidence, played an important role in this policy.

The meeting in October, 1970, led to an agreement between NASA and the Soviet Academy to study the development of compatible rendezvous and docking systems for U.S. and Soviet spacecraft. The agreement was formally ratified by Premier Kosygin and President Nixon during the President's visit to Moscow in May, 1972, and led to the decision to proceed with the joint orbital mission, which was announced in October, 1972.

Although it was agreed from the start that developing a compatible docking system was the main objective, NASA made every effort to enhance the scientific return from the mission. Since the project is essentially two separate space flights, the plans for scientific experiments have for the most part been carried out independently in the United States and the Soviet Union.

Over the years, NASA has developed a standard procedure for selecting the experimental payload for its manned and unmanned space flights. Once a mission has been approved, an announcement of flight opportunities—commonly referred to as an AFO—is sent to a distribution list composed of research laboratories in this country and many western European nations, soliciting suggestions for experiments. Anyone on the list may submit a formal, written proposal outlining an experiment and the instrumentation it will require. The proposals are then categorized, criticized, rated, and reviewed by various committees before final selection.

Although most people think the U.S. space program is exclusively national, NASA's payload selection system has led to the inclusion of foreign-originated experiments on various missions. The Mariner 10 Venus fly-by launched in November, 1973, for example, had an experiment proposed and paid for by a German group. And the Pioneer 11 Jupiter and Saturn fly-by, launched in August, 1973, carried an experiment proposed, constructed, and paid for by the French. The Russians also have performed French experiments on their space vehicles.

The NASA payload selection system is designed to get the best scientific value within the constraints of weight, astronaut and vehicle safety, and cost considerations, but it involves a great deal of paper work, is very time consuming, and once selections are made, may require years for the development of hardware. Thus the experiments for Viking, the first U.S. Mars landing probe, planned for August, 1975, were selected almost six years before the scheduled launch. The Apollo-Soyuz mission

Bob CAMPBELL

We'll die ..!

Survival of the fittest and fleetest on E.Africa's plains is hard enough, without poachers, their snares and fires added to our battle. They, and those who sent them, are after our skins hides, furs, claws, hooves, horns and teeth. But believe me, we need them more than they. However if we don't get help soon,we'll go the same way as the Dodo. To extinction.

You are our hope and our help, and the link between us is the EAST AFRICAN WILD LIFE SOCIETY, East Africa's own conservation group, and the first of its kind in the tri-nation area of Kenya, Uganda and Tanzania.

It is non-profit, non-governmental, a body that has funded a list of conservation projects since 1961, as long as your arm. Every cent of your membership (US$11.00) goes directly to game conservation projects; and not one cent to "overheads".

THE *WILDLIFE* GETS ALL THAT YOU GIVE

As a member of the Society you will also receive a year's subscription to AFRICANA the quarterly wildlife magazine. And for those who are interested in gifts of every description which have to do with the game of East Africa, a 32 page colour brochure is available for US$ 1.00. They are also on sale from our gift shop and gallery in the Nairobi Hilton Hotel.

And while you're reading this, remember, that the Society is working round the clock on our behalf, in the field of education, anti poaching, research and animal rescue.

USA Representative:
Miss Alice Smith Box 1325, Chicago Ill. 60690

EAST AFRICAN WILD LIFE SOCIETY
Box 20110 Nairobi Kenya.

Please enrol me as a member.
I enclose US.$11.00 for my year's membership.

Name ____________________
Address. ____________________

Apollo-Soyuz Test Project Experiments

Experiment	Purpose	Principal Investigator and Institution
Physical Sciences		
Extreme ultraviolet astronomy	To map the sky at wavelengths below 1,000 A and to measure the distribution of helium in the interplanetary medium.	C. Stuart Bowyer University of California, Berkeley, Calif.
Sky X-ray observations	To map the sky at X-ray energies in the range of 0.1 to 1.0 keV.	Herbert Friedman Naval Research Laboratory, Washington, D.C.
Ultraviolet atmospheric absorption	To measure the concentration of atmospheric gases by ultraviolet absorption.	Thomas M. Donahue University of Michigan, Ann Arbor, Mich.
Technology		
Surface-tension-induced convection in encapsulated liquid metals	To determine the influence of convective effects caused by variations in surface tension during heating of selected metal alloys.	Richard E. Reed Oak Ridge National Laboratory, Oak Ridge, Tenn.
Influence of weightlessness on the immiscibility of monotectic alloy systems	To define influence.	Choh-Yi Ang Northrop Corporate Laboratories
Role of convection in solidification processes in high coercive strength magnets	To define same.	David Larson Grumman Aerospace Corporation
Determination of zero gravity effects on electronic materials processing	To define same.	H. C. Gatos Massachusetts Institute of Technology, Cambridge, Mass.
Crystal growth from vapor phase in zero gravity environment	To define influence of gravity.	Herbert Weidemeier Renssalear Polytechnic Institute, Troy, N.Y.
Zero-G solidification of NaCl-LIF eutectic	To produce samples with high degree of orientation, regularity, and fiber continuity.	Alfred S. Yue University of California, Los Angeles, Calif.
Applications		
Electrophoresis	To analyze, purify, and isolate samples for medical and biological research.	Kurt Hanning Max Planck Institute for Biochemistry, West Germany
Doppler tracking	To study structure of the earth's gravitational field.	George C. Weiffenback Smithsonian Astrophysical Observatory, Cambridge, Mass.
Life Sciences		
Polymorphonuclear leukocyte response to infection	To study same.	R. Russel Martin Baylor College of Medicine, Houston, Texas
Effects of space flight on the cellular immune response	To study same.	B. Sue Criswell Baylor College of Medicine, Houston, Texas
Microbial exchange	To define microbial load and exchange.	Gerald R. Taylor NASA, L.B. Johnson Space Flight Center, Houston, Texas
Biostack	To identify effects of cosmic rays on biological material.	Horst Bucker University of Frankfurt am Main, West Germany
Optical sensations from cosmic rays	To study optical sensations experienced by the crew.	Cornelius A. Tobias University of California, Berkeley, Calif.

was on a tight schedule, so new procedures were necessary.

NASA administrator James C. Fletcher convened an extraordinary one-day symposium of high-level scientists at Woods Hole, Massachusetts, on July 7, 1973, to talk about the project. Twenty-two scientists attended—eleven from NASA and eleven from the general scientific community. They discussed possible options for payload selection, suggested experiments and possible experimenters, and identified various strategies for the over-all mission. If possible, experiments were to take advantage of the special features of the mission—not only would the mission be manned but also two spacecraft would be available. Experiments of otherwise high quality would not be excluded, however, if they failed to satisfy that criterion. There had to be high confidence that any prospective experiment could be designed and built on time. In practice, this requirement restricted investigations to those using equipment that was already at an advanced stage of development.

The participants at the symposium recommended that NASA send out its customary announcement of flight opportunities and that it also conduct an informal screening of proposals as soon as they were received at the agency's headquarters in Washington, D.C. This procedure would immediately eliminate proposals of clearly inferior quality and also isolate potential technical problems. Recommendations for flight experiments were to be made by an *ad hoc*, external advisory group, meeting face-to-face at an early date with NASA technical personnel and with prospective investigators in an attempt to identify the optimal payload for the project.

The *ad hoc* committee convened in Houston on July 31, 1973, to review 137 proposals on hand at that time. The three-day meeting proceeded in a generally frenetic environment. Prospective principal investigators, who had not only suggested experiments but who would also have the contractual responsibility for delivering the experimental hardware and analyzing the data collected, had been invited to make a verbal pitch for their proposals and to answer specific questions on objectives and technical

TRAVEL THE WORLD OF LINDBLAD

JOURNEYS INTO ANTIQUITY

Lars-Eric Lindblad offers three journeys of classic beauty into Egypt's ancient past. You may desire to travel "A Thousand Miles Up The Nile." You may want to explore "The Blue & White Nile," which includes an expedition into Ethiopia. Or you may want to embark on a journey to "Lands Of Antiquity" which, in addition to Egypt, will take you to Greece and some of its historic islands. These three tours feature unique and exciting excursions into unrivaled archeological places. You will marvel at the sight of great temples and relics of true antiquity. SABENA AIRLINES—the finest in air travel will take you to Egypt and back. Write for our informative brochure or see your travel agent.

LINDBLAD TRAVEL, INC.
Dept. NHN 1174
133 East 55th St., New York, N Y 10022
(212) 751-2300

INSPIRED BY THE SENUFO TRIBE OF THE IVORY COAST

The three pendants of this necklace, stylization of turtles, are finished in 24 karat gold and are 2¼ inches high. The collar is of gold plated tubular beads, flat gold plated discs and serrated black wooden discs.

$26.00 ppd., member's discount inc., add sales tax where applicable

MUSEUM SHOP/American Museum of Natural History
Central Park West at 79th Street . . . New York, N.Y. 10024

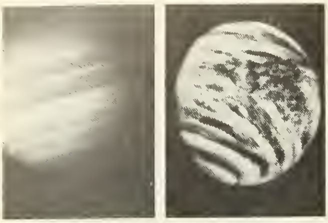
Please send me ________ necklaces. I enclose ________ check ________ money order for $________ total.

name . . . .

address . . . .

city . . . . state . . . . zip . . . .

Space Watchers:



PIONEER 10—set of 27 color & black/white 35mm slides . . . . **$9.50 set**
27—8x10 black & white photos **$25.00 set**

MARINER 10—set of 20 black/white 35mm slides . . . . **$7.50 set**
20—8x10 black & white photos **$19.50 set**

POSTCARDS—Views of SKYLAB, SPACE SHUTTLE, APOLLO/SOYUZ, and COMET KOHOUTEK. 3 each of 8 different views. Package of 24 cards **$2.00**

SPECIAL OFFER: 72 of the most important photos from APOLLO 15, 16, 17 and SKYLAB flights . . . . $10.50 set

Add 75¢ ($3.00 overseas) mailing and handling charges

Complete catalog beginning with GEMINI IV $1.00 (free with any order)

Space Photos
Dept. NH-2
2608 Sunset Blvd., Houston, Texas 77005

Great gift idea from California!

BLUE DIAMOND

ROASTED SALTED ALMONDS

Send these crisp, crunchy almonds and you'll never hear the end of the compliments. They make a wonderful snack by themselves . . . and they're terrific with cocktails. The handsome gift box opens to reveal a colorful six tin selection of six different kinds of almonds —Smokehouse®, Roasted Salted, Barbecue, Cheese, Blanched Salted and Onion Garlic.

Satisfaction guaranteed or your money back. And remember, the price includes delivery. Make your list of friends and relatives now. And don't forget to order for your house!

$6.50 postage paid. Send order with your name, address, check or money order to Dept. 4444, California Almond Growers Exchange, P. O. Box 1768, Sacramento, California 95808.

"These HAVE TO be the best-tasting nuts available today. First had them on the airlines—and when Christmas came last year we got a gift pack! Boy, oh boy—just the greatest!"
Mr. L. F. N., Seattle, Wash.

details. Such a confrontation had never been held before. The committee was to make its final decisions on the third day with a formal report to NASA.

August 1 was a long day for the advisory committee. Interviews with the investigators began at 8:00 A.M. and continued until after midnight. All the proposers had traveled to Houston at their own expense, some even interrupting their vacations.

After extensive deliberation, the committee rated the experiments in four, necessarily subjective categories, according to merit, and into four different discipline areas: the physical sciences (astronomy and space physics), technology, applications, and life sciences. An internal NASA committee met in Washington on August 10, 1973, to select the final payload from that list. Their recommendations, approved by Fletcher, took into consideration cost restrictions identified by agency personnel as well as the merit factors defined by the advisory committee. NASA had set an over-all cost ceiling of $10 million for all the mission experiments. Of this sum, $8 million was allotted to experiments in the physical sciences and applications, with the remainder going to the life sciences and technology. The recommended final payload of sixteen experiments included three from the physical sciences, six from technology, two from applications, and five from the life sciences.

In the area of the physical sciences, one experiment, proposed by C. S. Bowyer, an astrophysicist at the University of California, Berkeley, is designed to provide a systematic map of the ultraviolet sky at wavelengths below 1,000 angstroms. Earlier unmanned missions—the orbiting observatories and the X-ray satellites—had concentrated on either longer or shorter wavelengths. If sources of extreme ultraviolet radiation, for example, stellar coronae, defunct pulsars, or stars in the accretion phase, were discovered in this region of the spectrum, new areas of astronomical research would be opened up. Bowyer's instrumentation complements an ultraviolet experiment studying atmospheric gases that was conducted on board the deep-space probe Mariner 10, which flew close to Venus and Mercury earlier this year. That experiment demonstrated the rich potential of extreme ultraviolet astronomy.

An experiment suggested by astrophysicist Herbert Friedman of the Naval Research Laboratory in Washington, D.C., would extend and complement earlier rocket and satellite observations of the sky at X-ray wavelengths. X-ray astronomy is one of the great success stories of recent space science. The X-ray satellite Uhuru, launched in 1970 to search the sky for objects that radiate X-rays, found an impressive variety of X-ray sources and made possible the first tentative identification of an astronomical black hole. Friedman's experiment promises new advances in this frontier field of astronomical research.

The third experiment in the physical science area, proposed by Thomas M. Donahue, chairman of the department of Atmospheric and Oceanic Science at the University of Michigan, is designed to measure the concentration of highly reactive atomic species in the earth's upper atmosphere. The primary targets are atomic oxygen, the major atmospheric constituent at the mission's flight altitude, and atomic nitrogen, a minor constituent, which is known, however, to play a dominant role in upper atmospheric chemistry. These atomic species are not readily measured by conventional mass spectrometric techniques. They tend to react with exposed surfaces in a mass spectrometer, confusing the interpretation of the instrumental response.

Donahue's experiment takes advantage of the presence of two spacecraft on the mission. Ultraviolet light from a laser aboard Apollo will be sent through a telescope to an array of retro-reflectors mounted on Soyuz. The light beam will then be reflected back to Apollo, where it will be detected and analyzed by an optical spectrometer. Some of the light will be absorbed by the gas between the two spacecraft. When they are far apart, there will be strong absorption; when they are close, there will be weak absorption because of the presence of less absorbing material. The amount of absorption will provide a measure of the concentration of atomic oxygen and nitrogen in the atmosphere.

Careful guidance and attention by both astronauts and cosmonauts is essential to the successful implementation of this experiment. In this sense the ultraviolet experiment occupies a unique position in the test project. In order to facilitate the cooperative requirements, a senior Soviet scientist, V. G. Kurt, has been designated as a coinvestigator, and the Soviets have agreed to mount the necessary retro-reflectors in their Soyuz spacecraft.

The experiments in the area of technology are generally designed to identify possible advantages of the low-gravity space environment for various manufacturing processes. Most of the experiments will treat packages of materials in a small, multipurpose, electric furnace on board the Apollo spacecraft. The furnace is similar to the one carried earlier on the Skylab space station. One package will be delivered by the Russians, run through the oven, and returned to them for analysis. Space processing of materials on a commercial scale might become feasible and economically viable in the 1980s after introduction of the space shuttle and its associated space laboratory.

In the category of applications, there is an experiment proposed by Kurt Hanning, a biochemist at the Max Planck Institute for Biochemistry, in West Germany, designed to analyze, purify, and isolate samples for medical and biological research using continuous deflection electrophoresis. Samples to be studied include ions, colloids, and such biological materials as proteins, viruses, and cells. By isolating biological materials in pure form, this experiment carried out in space may eventually find application as a means of isolating rare vaccines and serums to be used for medical purposes on earth. The low-gravity space environment allows higher flow rates and enhanced separation yields compared to those that can be realized in ground-based laboratories using the same techniques. Flow rates and yields are limited in terrestrial laboratories by such factors as heat convection, sedimentation, and buoyancy, which result either directly or indirectly from the pervasive presence of the earth's gravity.

Another applications experiment, suggested by geophysicist George C. Weiffenback of the Smithsonian

TRAVEL THE WORLD OF LINDBLAD

Traveling with

LINDBLAD IN INDIA

is an unforgettably beautiful experience.

Today India offers more to see than virtually anywhere else in the world. You will encounter richness and beauty. See the great architecture of the Moghuls. Travel the huge forests where you find tiger, rhino and incredible bird life. See the famous nature preserves. You will come upon different life styles of many people, rich and poor. You may shop in bazaars reminiscent of the days of Rudyard Kipling. And you will travel in small groups. Quality is the key word to Lindblad's well-planned India Expeditions. We offer the Himalayan Nature Tour and Incomparable India. On our program also is Bhutan and Burma as well as the ever-popular Expedition to the Borderlands of Tibet. The Kashmir Extension is available to all except Bhutan and Burma Excursion. **Air-India** will fly you to these tours in superb comfort. Please write for our "Lindblad in India" brochure, or see your travel agent.

LINDBLAD TRAVEL, INC.
Dept. NHIN 1174
133 East 55th Street, New York, N.Y. 10022
(212) 751-2300

"An orderly, concise and scientifically up-to-date look at earthquakes from almost every angle.... Halacy presents in lucid...terms precisely what his readers might want to know about earthquakes. His chapters are brisk and interest never flags." —*Publishers Weekly*

55 black-and-white photographs $7.95

EARTHQUAKES

A NATURAL HISTORY

by D.S. HALACY Jr.

To order, send name, address, check or money order to
BOBBS-MERRILL
Dept. TG-NH
4 West 58th Street, New York, N.Y. 10019

The Rubáiyát of Omar Khayyám

This is a complete recording of Edward Fitzgerald's 5th version, and is the cumulative effort of three men of genius.

It is followed by a few comments and comparisons, and also Pedro Calderon de la Barca's The Dream Called Life and Life is a Dream.

Lastly, beginning with Hamlet's soliloquy, there is some of the best that is to be found in Shakespeare.

A purchaser writes: "The record is being played over and over, it is my treasure."

And from Canada, this judgment and request: "Because the record is such a beauty, send me another one . . ."

A superlative delivery of superlative poetry by Louis Zoul.

$8.00

Plus Applicable Sales Tax
(only for N.Y. State residents)
Available Only By Mail

PUBLIC OPINION
Box N-4044 Long Island City, Long Island
New York 11104

Ideal for Gift Giving . . .
1975 NATURAL HISTORY CALENDAR

Portraying Indians of the Great Southwest
Published by The American Museum of Natural History
Special Retail Edition

Only *Natural History* could bring you a calendar so beautiful . . . a tasteful gift to be valued even beyond the calendar year. Opening to full 12″x18″, the calendar contains a splendid portfolio of 9″x12″ color illustrations, each one worthy of framing, that depict American Indian culture and the scenic beauty of the Southwest.

Mail your order today to:

Natural History Calendar
Box 5123
Des Moines, Iowa 50306

My check is enclosed for $__________
☐ $2 One Calendar ______ Additional calendars at $1.50
Third-class Postage is included in the Calendar price
For first-class mail delivery, add 50¢ for each calendar

Name ....
Address ....
City .... State .... Zip ....

Astrophysical Observatory in Cambridge, Massachusetts, is intended to study the small-scale structure of the earth's gravitational field. Doppler radar tracking will be used to search for important clues to the internal distribution of the earth's mass. This study of gravitational anomalies will contribute to geologic and geophysical research on continental drift, earthquakes, and volcanic activity. The data can also be used to map the possible locations of various mineral resources. This experiment will use the Apollo-Soyuz VHF ranging system designed to measure small changes in the relative positions of the two spacecraft and thus aid the docking maneuver.

Experiments in the area of the life sciences are intended to study various effects of space flight on the human system. One experiment requires blood samples to be taken from the astronauts before and after the mission in order to learn the effects of weightlessness on polymorphonuclear leukocytes, the white blood cells that play a crucial role in determining the body's response to bacterial infection.

Another experiment, with similar goals, also involves an analysis of pre- and post-flight blood samples but has as its target lymphocytes, cells produced in lymphoid tissue that constitute 20 to 30 percent of the leukocytes of normal human blood. Lymphocytes regulate the body's response to infectious agents, either by creating antibodies that destroy infection or by transmitting information that alerts other cells to the imminent danger of infection.

Microbiological samples taken from the astronauts and cosmonauts and from the interiors of the Apollo and Soyuz spacecraft at selected times before, during, and after the flight will be studied in another life sciences experiment. The extent to which microbial exchange occurs between the crewmen during flight will be monitored.

The remaining life sciences experiments are designed to monitor the possible effects of cosmic rays on the astronauts and on selected biological materials. These experiments are similar to investigations conducted earlier on Apollo 16 and 17; the results should extend and complement those earlier studies.

The Russians have not publicized

the experiments they may be planning to conduct. NASA currently knows of only one, a project that involves solar eclipse photography. The cosmonauts expect to maneuver Soyuz so as to use the Apollo spacecraft as an occulting device to artificially eclipse the sun while they study its corona.

At this writing the prospects for the Apollo-Soyuz Test Project seem favorable. NASA is confident that the mission can be implemented on schedule, and the Soviets apparently share this view. The project is billed as a "test," but there are as yet no indications as to the nature of possible follow-up missions. Presumably, further joint earth orbital missions will be designed. There are, however, other more glamorous possibilities for cooperation in space. Both nations have pursued vigorous programs of Mars exploration. Four Soviet spacecraft were sent to Mars in 1973—two orbiters and two landers. NASA's Viking Project plans to land a pair of complex spacecraft on the surface of Mars in 1976 to search for the possible presence of life. As an obvious sequel to the present missions, the United States and the Soviet Union could plan a joint unmanned mission to recover samples from the surface of Mars during the mid-1980s. The technological challenges and potential scientific rewards of such a venture would be sufficiently great to justify a united effort in that direction.

As to the more distant future, can we exclude the possibility of internationally manned stations either on the moon or on Mars? If international cooperation and détente continue to progress, U.S. astronauts of the 1990s may be required to learn Chinese and perhaps even Arabic, as well as Russian, in order to communicate with their confreres in space. The prospect calls to mind an early prophecy by Soviet space theorist and philosopher Konstantin Tsiolkovsky: Earth is the cradle of mankind, but man cannot stay in the cradle forever.

Michael B. McElroy is professor of atmospheric sciences at Harvard University. Born in Ireland, he received his Ph.D. from Queens University in Belfast. He is a coinvestigator on one of the experiments to be carried out by the Apollo-Soyuz Test Project.

TRAVEL THE WORLD OF LINDBLAD

A totally fascinating new world dawns when you travel with

LINDBLAD IN AFRICA

Because we believe we spend more time and effort researching our African safaris than anyone else, we can offer the most rewarding journeys to this fabulous continent. Africa is a nature paradise and probably the most photogenic part of the world. It is teeming with an unbelievable variety of wildlife. And Lars-Eric Lindblad offers a wide selection of African tours. We operate our famed Wing Safari (why spend your vacation on dusty roads), The Lindblad Safari, The Botswana Wing Safari, and the Ethiopian Nature Safari.

You may want to visit historic Ethiopia and Yemen, the lovely Seychelles in the Indian Ocean, take our West Africa Safari or embark on our newly scheduled Round Africa Expedition. We travel only in small groups and our safaris, unlike most others, are all-inclusive. Write today for our comprehensive "Lindblad in Africa" brochure, or see your travel agent.

LINDBLAD TRAVEL, INC.
Dept. NHAF 1174
133 East 55th Street, New York, N.Y. 10022
(212) 751-2300

Archaeology

A MAGAZINE DEVOTED TO MAN'S PAST

You don't have to be an expert to enjoy ARCHAEOLOGY, the magazine written for the archaeologically-minded amateur. Reports of excavations and finds, interpretive articles and authoritative book reviews fill each lavishly illustrated issue. This unique quarterly is an official publication of the Archaeological Institute of America.

ARCHAEOLOGY–Dept. NH2
260 West Broadway
New York, NY 10013
$8.50—1 year $15—2 years
$22—3 years
☐ I enclose $______. ☐ Bill me
Please send ARCHAEOLOGY to:
Name______
Address______
______Zip______

Molding New Plants

Biologists are learning new tricks to alter and improve the genetic nature of plants

During the last two weeks of July, 1974, I attended two international scientific congresses in England that could have important consequences for our ability to mold plants to suit our needs. The Third International Congress of Plant Tissue and Cell Culture, held at the University of Leicester, included 600 participants from forty-three countries. The delegates went busily from large plenary summary lectures to briefer descriptions of recent research and demonstrations of new techniques. The second conference, held at the nearby University of Nottingham, was a smaller workshop on the use of plant and fungal protoplasts as genetic systems. This meeting, limited to about fifty visitors from fifteen countries, was convened under the sponsorship of the European Molecular Biology Organization. Many participants attended both the Leicester and the Nottingham meetings and were thus able to talk at length with colleagues doing similar work. As at all scientific conferences, questions were frequent, searching, and uninhibited. Some extravagant claims, unsupported by adequate data, had to be discounted; some theories, which seemed logical only yesterday, collapsed under the weight of new, previously unpublished data. New theories that emerged from the discussions will undoubtedly be tested in the years ahead and discussed further at scientific meetings. In this way the body of generally accepted scientific knowledge grows and changes from year to year.

A recent advance, described by A. C. Hildebrandt of the University of Wisconsin, is a new technique for obtaining virus-free plant strains from previously infected ones. When viruses become systemic, they are usually transmitted from generation to generation through seeds. After several generations, virtually every plant will be infected. Sometimes such plants, which look relatively normal, are used commercially, even though the grower is aware that the quality and productivity of his line have declined over the years. Hildebrandt showed how this downward trend could be dramatically reversed in one generation. His method depends on the fact that a virus does not penetrate all parts of the plant body; among the usually virus-free regions are the growing point at the extreme tip of the stem and the anther of the flower. If these organs are cut off the plant, sterilized with alcohol or diluted Clorox, and then placed in sterile nutrient media of the right kind, they will ultimately regenerate entire plants. The new plants will be virus-free and generally much more vigorous than the virus-laden plants from which they were derived.

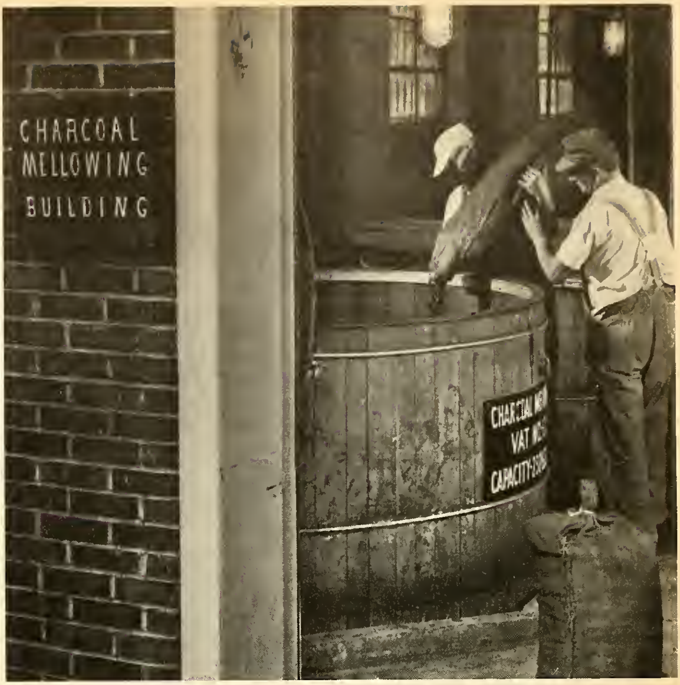
The stem tip grows first, generating a mass of callus cells, from which roots and new buds eventually arise, producing a new plant. The primordial pollen grains of the anther generally divide a few times and then, as discovered by Colette Nitsch of Gif-sur-Yvette, France, they produce an embryolike structure that also goes on to produce a vigorous, virus-free plant. At the time the pollen cells are formed in the plant, the process of meiosis reduces their chromosome number by half. The plants grown in a culture medium are therefore generally haploid (that is, have cells containing a single set of chromosomes and genes), rather than diploid (having cells containing pairs of chromosomes).

Haploid plant tissues are very useful to the plant breeder. For one thing, they are a source of new, pure-line diploids. All one has to do to develop a diploid is treat the haploid with the well-known drug colchicine, obtained from the plant *Colchicum autumnale*. This drug permits chromosomes to divide but prevents their subsequent separation into two discrete nuclei. Following colchicine treatment, the number of chromosomes per cell will thus be doubled. If the original haploid had six chromosomes (one each of six different chromosomes), the treated haploid, or diploid, will have twelve chromosomes (two each of six different chromosomes). Since each gene on every chromosome will have been exactly copied during chromosome replication, the resultant diploid will be either pure dominant or pure recessive for every genetic character; no gene pair will be present in the hybrid state. Plant breeders usually need about eight generations to achieve an equivalent result.

The haploid plant derived from a pollen grain is also useful—it can be used to produce new types of plants quickly. When there is only one gene of each kind, any mutation in that gene will show up immediately. By contrast, if one gene of a pair in a diploid mutates, the mutation may be recessive and thus hidden by the unaltered homologous normal gene. A haploid plant may be taken, its cells exposed to mutation-inducing chemicals, and mutations of various kinds detected. Most mutations are either harmful to the plant or innocuous, but some are definitely beneficial. For example, plant cells that are resistant to some fungus pest may be discovered after mutation-inducing treatment of susceptible cells. Propagation of the resultant plant by tissue culture techniques may yield a new line of resistant plants.

Certain cells, notably those of bacteria, can have their genetic nature changed not only through breeding and mutation, but also by the introduction of new hereditary material in the form of DNA. The DNA may be introduced by a virus (in a process called *transduction*), or purified DNA may be deliberately applied to the receptor cell (in a process called *transformation*). Can such experimental modifications be accomplished in plant cells? There have been several reports of positive results, but most workers remain somewhat skeptical.

Lucien Ledoux of Belgium reported recently that he had corrected a genetic deficiency in a mutant strain of *Arabidopsis,* a small member of the mustard family, simply by flooding the roots of the young seedling with a solution of DNA obtained from a bacterium



NOT EVERYONE KNOWS the difference between charcoal mellowing and aging. But it only takes a minute to explain.

All distillers age their whiskey. But only Jack Daniel's seeps it for days through 12 feet of finely ground charcoal before aging begins. *This* is charcoal mellowing, the step that no other whiskey-maker uses. Then our whiskey is aged in a charred oak barrel to mellow its taste even further. After charcoal mellowing, most folks find Jack Daniel's awfully smooth. After aging it's even smoother.

4/5 QUART
JACK DANIEL'S
Old No. 7
Tennessee
SOUR MASH
WHISKEY

CHARCOAL
MELLOWED
DROP
BY DROP

Tennessee Whiskey • 90 Proof • Distilled and Bottled by Jack Daniel Distillery
Lem Motlow, Prop., Inc., Lynchburg (Pop. 361), Tennessee
The first Distillery placed in the National Register of Historic Places by the United States Government.

oneness

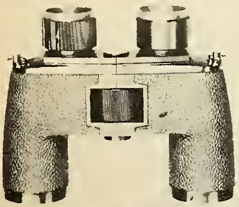
A subtle linking of man's religious symbols, delicately wedded together by the artisan.

With illustrated descriptive booklet.

14K with 24" chain $37.50
Sterling Silver $16.75
ISAAC SOLTES DESIGN NH
1923 S. McPherrin Ave.
Monterey Park, Calif. 91754
Check or Money Order / Money-back Guarantee

MINERALS
FOSSILS
SHELLS
INDIAN ARTIFACTS

Send 50¢ for Illustrated Catalog
DOVER SCIENTIFIC
Box 6011 C Long Island City, N.Y. 11106



BUSHNELL 7x35 CUSTOM
Mfg. List $149.50 Postpaid $89.50

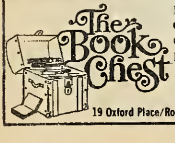
This is an example of the deep discount prices on high quality optics that is found in our FREE catalog. This catalog lists and illustrates on outstanding selection of camera lens, telephoto lens, telescopes, binoculars etc., plus valuable information on how to properly select them. Write for it today.

GIL HEBARD OPTICS
COURTHOUSE SQ., KNOXVILLE, ILL. 61448

MINERAL CATALOG

Send only 50¢ for illustrated Catalog listing large selection Crystals, Minerals, Rocks, Collections, Geological Oddities. FREE: Send Self Addressed Stamped Envelope for list of Crystals and Crystal Groups. (Will automatically be included if you order Catalog.)

FILER'S MINERALS
Box 487-NH Yucaipa, Calif. 92399



out of print, scarce, rare NATURAL HISTORY BOOKS
Botany, Zoology,
Orchidology,
Ornithology, Entomology,
Ichthyology,
Herpetology, etc.
CATALOGUE 7 AVAILABLE
The Book Chest
19 Oxford Place/Rockville Centre, New York 11570

that did not have the mutant's deficiency. The inference is that bacterial DNA entered the plant, became part of its genetic structure and, by causing the synthesis of appropriate enzymes, corrected the deficiency of the plant cells.

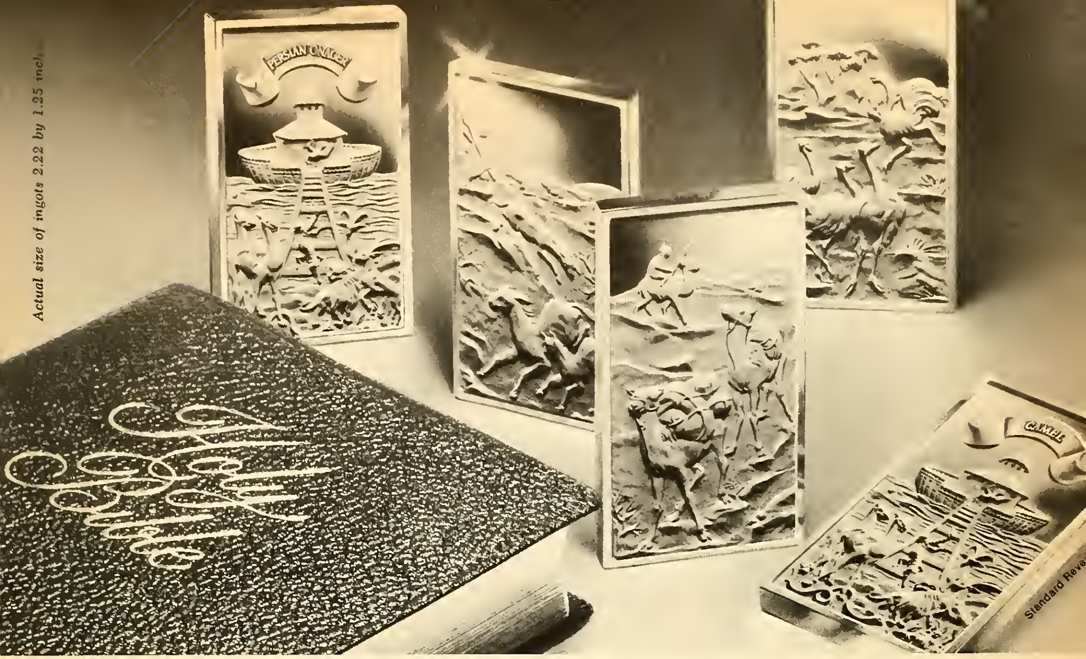
Dieter Hess of Germany similarly reported that when DNA from a red-pigmented *Petunia* was injected into a genetically albino *Petunia* seedling, it caused some red color to appear. Once again, the inference is that the donor DNA entered the receptor and was incorporated into the regular genetic apparatus, leading to the expression of the genetic potential for pigment production. Unhappily, this transformed genetic state did not persist uniformly in the progeny, and Hess's experiment is very difficult to interpret.

Colin Doy and his colleagues in Australia grew a tissue culture of tomato on a synthetic chemical medium. Such cultures cannot normally utilize the sugar lactose for growth, but when treated with a bacterial virus containing the gene for lactose utilization, they were able to do so on a very small scale. C. B. Johnson and his colleagues in Sutton Bonnington, England, obtained similar results with cultures of sycamore cells. In both cases, the data are somewhat equivocal because the results are small in magnitude and not clearly genetically persistent. Most scientists remain unconvinced that true transfer of DNA has occurred from the virus to the cell.

What would be accepted as an unambiguous demonstration of the transfer of genetic information from one cell to another? Almost everyone at the two congresses agreed on the following ideal experiment. Haploid tissue, derived initially from a culture, should be separated into individual cells through the use of pectinase, an enzyme that digests the intercellular cement binding cells together. These cells should then be placed individually on agar in specially devised synthetic media, permitting them to be tested for various biochemical mutations. Suppose one cell is found that is resistant to a fungal toxin that kills normal cells. Through tissue culture, this new resistant cell should be grown into a plant. It could then be propagated as a haploid or diploid and, in the latter form, might even be useful as a new fungus-resistant strain. The DNA from this resistant plant could be extracted and an effort made to introduce it into the cells of a normal, susceptible plant. The best way to do this is to begin with naked protoplasts of normal cells, prepared by exposing single cells to the action of the enzyme cellulose, which digests cell walls. The membranes of such naked protoplasts can engulf fairly large particles, much as an amoeba surrounds and ingests its food. If the normal protoplast, which is susceptible to the toxin, takes up the DNA extracted from resistant cells, it may become resistant itself. If so, the protoplast should be able to grow on a toxin-containing medium that normally would kill it. If it grows into a plant, and if such a plant behaves genetically like a resistant plant, passing the resistant characteristic on to its offspring in a typical Mendelian fashion, then everyone would agree that the normal protoplast had been transformed by the DNA extract.

Is such an experiment feasible at present? Probably, although only six genera (tobacco, petunia, carrot, bean, asparagus, and snapdragon) have been successfully propagated from single, isolated protoplasts. But as the techniques of protoplast culture, cell culture, and DNA isolation are improved, the likelihood of success will increase. I believe that this experiment will be successfully carried out within a decade. Once it is done, all sorts of new tricks will be available to alter and improve the genetic nature of plants. Naked leaf protoplasts from two different species of tobacco have already been fused to produce a hybrid. It is not too farfetched to believe that new, desirable forms of DNA, extracted from plants and replicated in bacteria, could be introduced into receptor plants through protoplast feeding or through carrier viruses. From such experiments may come higher-yielding crops, proteins of better quality, disease resistance without the use of pesticides, and even an extended range of nitrogen fixation, which would obviate the use of nitrogenous fertilizers. Because of these possibilities, this is an exciting time for botanists.

Columnist Arthur W. Galston teaches biology at Yale University.



Actual size of ingots 2.22 by 1.25 inch

The Treasury of Biblical Wildlife.

24 sculptures of Holy Land animals in ingots of solid sterling silver.

Once, the birds, the beasts and the reptiles dwelt in profusion in the land of the Bible. Centuries of neglect and environmental change have severely reduced their numbers. *By owning this unique collection, you help restore and protect them.*

Bible Animals of the Series

The Persian Onager, Nubian Ibex, Mesopotamian Fallow Deer, Wild Ox, Syrian Bear, Arabian Oryx, Asiatic Lion, Indian Wolf, Rock Hyrax, Roe Deer, Sheep, Wild Boar, Dorcas Gazelle, Camel, Fox, Stork, Cheetah, Crocodile, Arabian Horse, Ostrich, Serpent, Saluki Dog, White Ass, and Dove.

24 Original Works of Art

This unique collection of 24 individual works of art in solid sterling silver was created exclusively for The Biblical Wildlife Society by Dora de Pédery-Hunt, member of the Royal Canadian Academy of Art. Her sensitive and inspirational sculpture is part of the collections of Canada's National Gallery, the Belgian Royal Cabinet of Medals, the Dutch Royal Coin Cabinet, and the Smithsonian Institution.

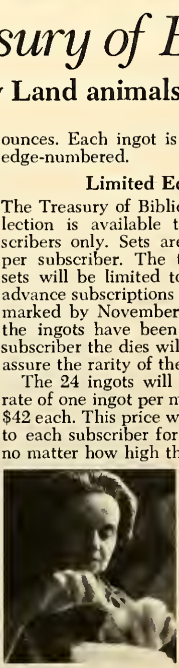
Produced by The Franklin Mint

The Franklin Mint, world's foremost private mint, was selected for the production of these solid sterling silver ingots. Each proof quality ingot contains 750 grains of silver, 1.6 troy ounces. Each ingot is hallmarked and edge-numbered.

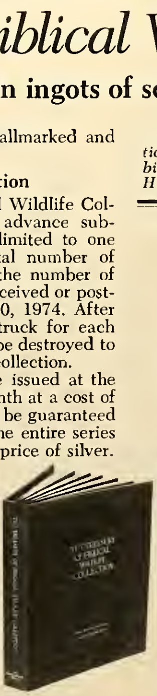
Limited Edition

The Treasury of Biblical Wildlife Collection is available to advance subscribers only. Sets are limited to one per subscriber. The total number of sets will be limited to the number of advance subscriptions received or postmarked by November 30, 1974. After the ingots have been struck for each subscriber the dies will be destroyed to assure the rarity of the collection.

The 24 ingots will be issued at the rate of one ingot per month at a cost of $42 each. This price will be guaranteed to each subscriber for the entire series no matter how high the price of silver.



Dora de Pédery-Hunt



A deluxe collector's album with parchment pages of biblical texts referring to the animals of the bible will be provided at no additional charge to each subscriber to The Treasury of Biblical Wildlife.

The Biblical Wildlife Society contribution to the protection and restoration of biblical wildlife is directed through the Holy Land Conservation Fund Inc., N. Y.

SUBSCRIPTION APPLICATION

Limit: One series per subscriber.

Valid Only if Postmarked by November 30, 1974

The Biblical Wildlife Society, Suite 4008
866 United Nations Plaza, N. Y. 10017

Please accept my subscription application for one serially-numbered First Edition Proof Set of *The Treasury of Biblical Wildlife Collection*, minted for The Society by The Franklin Mint. The complete series will consist of 24 solid sterling silver ingots, to be issued at the rate of one ingot per month.

I enclose $42* as payment for the first ingot in the series to be delivered in December 1974. I will pay for each subsequent ingot promptly upon being invoiced on a monthly prepayment basis.

*N.Y. residents add appropriate sales tax.

(please print)

Name____________________

Address____________________

City____________________

State/Zip__________Tel:__________

Signature____________________

Orders subject to acceptance by The Biblical Wildlife Society.

N

The Biblical Wildlife Society • Suite 4008, 866 United Nations Plaza, New York, N. Y. 10017 • (212) 421-2960

The Great Irish Telescope

A nineteenth-century peer of County Offaly lovingly built the right instrument in the wrong place

by Trevor C. Weekes

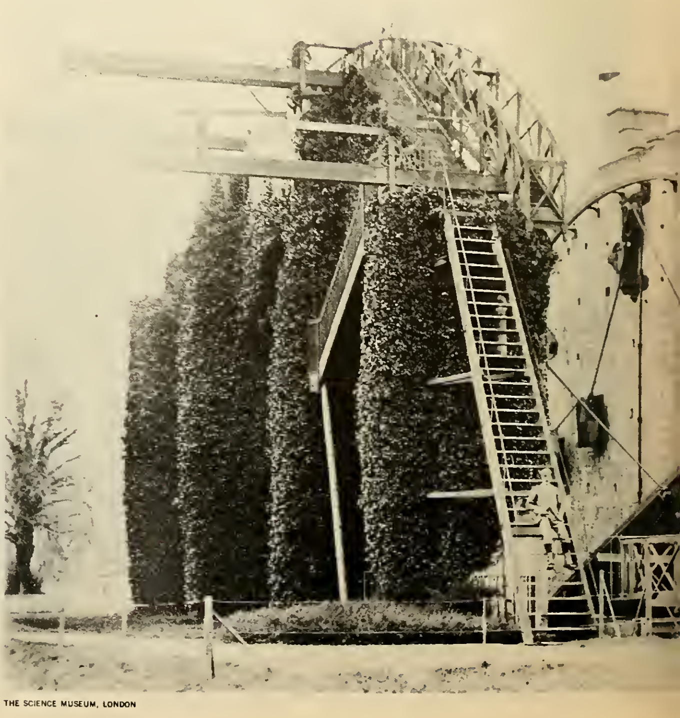
In the famine-stricken countryside of mid-nineteenth-century Ireland, a traveler coming upon the "Leviathan of Parsonstown" would scarcely have believed his eyes. This was a giant telescope, the creation of William Parsons, the third earl of Rosse. It is equally astonishing today that what was to be the world's largest telescope for seventy-two years should have been built entirely on the earl's country estate at Birr, also known as Parsonstown, County Offaly, in the geographic center of the country. Lord Rosse designed and built this 72-inch telescope solely with the aid of the peasants on his estate, who were literally "taken from the plow" and instructed by him in all the complex arts of telescope making.

Even by modern standards, the telescope's dimensions were impressive. The primary mirror, made of metal, was 72 inches in diameter, 6 inches thick, and weighed six tons. The telescope tube was 58 feet long. The instrument—completed in 1845, the year of the Irish potato famine—was mounted in front of Birr Castle, between two immense walls that were 50 feet high, 70 feet long, and 23 feet apart. Not until 1917, when the 100-inch reflecting telescope was installed at Mount Wilson in California, was a telescope of larger aperture constructed.

The political structure of Ireland at the beginning of the last century was such that the vast majority of the population lived in wretched poverty with the potato as their staple diet, while an elite minority enjoyed considerable wealth. Many of the aristocracy spent their lives abroad or in private pursuits on their vast estates, but a few made a distinguished contribution to the arts and sciences. William Parsons, Lord Oxmanton, who became the third earl of Rosse, was an outstanding example of this latter group.

Born in 1800 to a wealthy and titled family, he was educated at home by private tutors. Later he went to Trinity College, Dublin, and to Oxford University, where he received a first in mathematics. While still an undergraduate he was elected to the House of Commons in London as the member for Offaly. He served in the Commons from 1821 to 1834, but after inheriting his father's earldom in 1841, he sat in the House of Lords. His political career was undistinguished. From an early age his prime interest had been in engineering pursuits, to which he devoted himself completely after 1834. Sir Robert Ball, royal astronomer of Ireland, said of Lord Rosse, "In the possession of leisure and of means, he deliberately cast around to think how that means and that leisure could be most usefully employed. . . . He came to the conclusion that the building of giant telescopes was an art, which had received no substantial advance since the great days of William Herschel."

One of the greatest of observational astronomers, Herschel, who died in 1822, had built a reflecting telescope with a 48-inch aperture. Among his achievements was his discovery of the planet Uranus. But because Herschel's large telescope was generally disappointing, it was

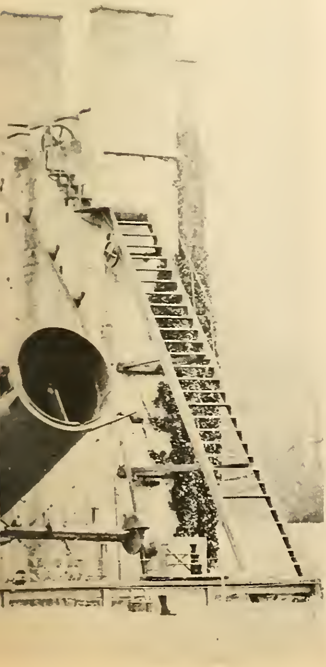


THE SCIENCE MUSEUM, LONDON

widely believed that refracting telescopes, whose prime elements are lenses, had a greater sensitivity than reflecting telescopes, whose prime elements are mirrors. Much of the activity in instrumentation for astronomy at the beginning of the last century was therefore directed toward the improvement of refracting telescopes, chiefly by the use of higher-quality glass in the lenses, rather than toward the construction of even larger reflecting telescopes. After some early, unsuccessful experiments with lenses, Lord Rosse decided that the construction of a reflecting telescope larger than Herschel's would be a project not only worthy of his talents but also within his resources.

The undertaking was severely hampered, however, by the lack of available information on the best optical techniques of the day. The most skilled opticians were craftsmen who regarded their techniques and processes as personal secrets. In fact, the eighteenth-century Scottish optician James Short had developed the art of giving a metallic mirror a parabolic surface that was nearly distortionless, but so jealous was he of his secret, that shortly before he died he ordered the destruction of all his tools. Even Herschel published little regarding the techniques he had used in the manufacture of large specula, as these metal mirrors were called. Lord Rosse was therefore forced to start from scratch and educate himself in optical techniques. Because his estate was located deep in rural Ireland, far from the industrial centers of Dublin and Belfast, he had no skilled craftsmen at his disposal—only the local peasantry who had served his family for generations. With great patience he undertook the task of training his employees in the most sophisticated optical techniques then known. Although not a trained engineer, he had a natural talent for optical engineering; within ten years he knew as much as anyone about the design and construction of telescopes. All his research work was funded from his own estate.

For some years Lord Rosse devoted himself to the complexities of casting metal mirrors. Much experi-



A visitor in the early 1900s poses alongside Lord Rosse's 72-inch reflecting telescope, known as the "Leviathan of Parsonstown."

A GUIDE TO ANCIENT MAYA RUINS
by C. Bruce Hunter

A Guide to Ancient Maya Ruins

By C. BRUCE HUNTER

Covers the Maya ceremonial areas in Mexico, Guatemala and Honduras. The author is Lecturer in Archaeology for The American Museum of Natural History.

Hard-cover **$10.70 ppd.**
Soft-cover **$ 5.70 ppd.**

15% discount for museum members.
Please add Sales Tax where applicable.

MUSEUM SHOP
The American Museum of Natural History
Central Park West at 79th Street
New York, New York 10024

Please send me ______________copies
☐ Hard-cover ☐ Soft-cover.
I enclose __________check or__________
money order for $ __________total.

name______________________________

address____________________________

city_______________________________

state ________________ zip __________

Orders for hard-cover books placed before December 25, will be autographed upon request.

Our tie with a past.

A faithful representation of the bona fide Concord Minuteman. Available at our Men's Shops or by mail. In Navy, Brown, Maroon, or Dark Green (the man himself in bronze). 100% polyester. $8.00. Postpaid. The Country Store of Concord, 15 Monument Street, Concord, Mass. 01742.

The Country Store of Concord

Concord, Westwood, Beverly Farms, Edgartown, Nantucket, Mass., Guilford, Greenwich, Ct. Far Hills, N.J., Falmouth, Me.

MERELY MAGNIFICENT Made in Italy exclusively for The Collection, this table lighter is mounted into a Conus Leopardus sea shell (and nature has seen to it that no two shells have exactly the same coloring or size). The lighter is butane fueled and refillable. #3060A. **37.50** (1.50 postage and handling).

FROM THE HORCHOW COLLECTION
P. O. Box 34257, Dept. 01812
Dallas, Texas 75234

☐ Send me_____Sea shell lighters. Check enclosed.

☐ Please add me to your catalogue mailing list.

mentation was required before the right compromise in the composition of the alloy was arrived at. The alloy he finally chose, consisting of four parts of copper to one of tin, is difficult to work with; it can be as hard as steel and as brittle as glass. Too much copper and the reflecting surface is an inefficient dull brown; too much tin and the slightest knock will crumble the mirror.

Lord Rosse perfected his technique by first casting small mirrors. Finally in 1840 he made a mirror with a 36-inch aperture. Mounted in a 26-foot tube on an altazimuth mount, which permits rotation in horizontal and vertical planes, it was essentially the same design as the one used by Herschel in his 48-inch telescope. Preliminary observations showed that this instrument was comparable in quality to any in existence. Lord Rosse could thus be confident that he had equaled, if not surpassed, the other telescope makers of his day. But he was not content with that achievement and set out to build a telescope with four times the collecting area of his 36-inch instrument.

His experience with smaller mirrors led Lord Rosse to believe that his technique would work equally well in casting large ones. In fact, it took five attempts over five years before he succeeded in casting a mirror of satisfactory quality with a 72-inch aperture. A lesser man would surely have become disheartened and indulged himself in a more immediately rewarding pursuit. Each mirror required six tons of raw materials, which had to sit for sixteen weeks after casting in a specially constructed oven that allowed the metal to cool evenly without cracking. The contemporary director of Armagh Observatory left a vivid account of the casting of the immense mirrors:

> Above, the sky crowded with stars and illuminated with a most brilliant moon seemed to look down auspiciously on [the] work. Below, the furnaces poured out huge cauldrons of nearly monochromatic yellow flame and the ignited crucibles during the passage through the air were fountains of red light producing on the towers of the castle and the foliage of the trees such accidents of color as might almost transport fancy to the planets of a condensed double star.

If the mirrors survived the critical cooling process, they were ground and optically polished in an operation that determines the optical quality of a reflector. Eventually Lord Rosse got a large mirror that met his exacting standards.

The massive speculum was mounted in the telescope on twenty-seven felt-covered platforms of cast iron set atop a complicated system of supports designed so that the figure of the mirror would not change with different orientations of the telescope. The 58-foot-long telescope tube was made of barrel staves of plain, unfinished wood bound together with iron hoops. In size and appearance the telescope resembled one of the round towers that dot the Irish landscape. These structures, attached to monasteries, served monks in the early Middle Ages as places of refuge from attacking Vikings. The lower extremity of the telescope tube rested on a universal joint of cast iron and could be moved about this joint between the two massive stone walls constructed outside Birr Castle. These walls acted both as a windbreak (the equivalent of the modern telescope dome) and as the support for a complicated series of pulleys and counterweights that made it possible to direct the telescope at a chosen celestial object for study. The astronomer rode on a special platform and shouted instructions to the three workmen needed to move the "Leviathan." The solid walls reduced the amount of sky visible to the telescope so that the astronomer was essentially limited to viewing objects within 10° of either side of the north–south line.

In February of 1845, when the telescope was at last completed, Lord Rosse began his first observations. Although viewing was severely handicapped by cloudy weather, the sky was clear often enough to convince him and his astronomical companions that his efforts had not been in vain. During the same year, however, the dread specter of famine hung over Ireland. A massive failure of the potato crop dramatized the disastrous consequences of an economic structure that forced the peasantry to depend on a single crop for subsistence. Astronomical activity at Birr

Castle consequently ceased, and Lord Rosse devoted himself to relief work. Three years later, when social conditions had improved sufficiently, he commenced a vigorous program of observations that continued until his death in 1867. Before 1848, he had been primarily a telescope builder; subsequently he became an astronomer and concerned himself with the burning scientific issues of his day. Many of his observing assistants ultimately became distinguished astronomers in their own right; Birr Castle became one of the most important, if unlikely, centers of scientific activity in Europe. The third earl of Rosse received many scientific honors for his efforts, including the presidency of the Royal Society, the oldest scientific organization in Great Britain, and the chancellorship of Dublin's Trinity College.

The quality of the drawings of astronomical objects made at the 72-inch telescope confirms the belief that the instrument's optical performance was excellent. The observational results achieved were not, however, as exciting as might have been expected considering that the "Leviathan" was for so long a time the largest telescope in the world. The somewhat disappointing observations can be traced to two factors: the telescope's mounting and its location. The cumbersome system for moving the instrument made observing laborious and restricted the degree to which particular objects could be studied. And, because of its weather conditions and low altitude, the center of Ireland, although a charming site for an ancestral castle, is one of the least suitable locations imaginable for a major optical telescope. To minimize the distorting effect of the earth's atmosphere, modern astronomers construct their telescopes on mountaintops. To get the maximum amount of observing time, the mountain sites selected are usually in desert climates.

Studies of nebulae made by Lord Rosse and his associates constitute the outstanding work done with the 72-inch telescope. These faint, diffuse objects were the subject of much controversy in the last century. Some observers believed them to be regions of luminous fluids. Others held they were conglomerations of faint stars so distant they could not be resolved individually. Only large telescopes such as Lord Rosse's had the sensitivity and the resolution required to study these objects. One such cloudy patch in our galaxy, seen to contain many clawlike projections, suggested to him the shape of a crab. He named it the Crab Nebula. The name stuck, and the Crab remains an object of consuming interest to today's astronomers as they seek further knowledge of supernovae, pulsars, and neutron stars.

With his giant telescope, Lord Rosse discovered that many nebulae that had previously been unresolved were actually composed of millions of stars. But other nebulae remained unresolved, leading some astronomers to conclude that with still larger telescopes these too might be resolved. Today we know this is not the case. Two types of nebulae exist: planetary nebulae, which are comparatively nearby objects composed of glowing gas; and star clusters, which may be nearby or may be distant galaxies—star systems similar to our own Milky Way. The meticulous observations recorded at the 72-inch telescope showed that many of these latter systems had a complex spiral structure; drawings made at the telescope compare favorably with photographs taken with the most sophisticated modern techniques.

The astronomical tradition at Birr Castle was continued by Lord Rosse's son, the fourth earl, who inherited the title on his father's death. He made a number of improvements in the telescope and was the first to measure the temperature of the moon. The most active years at Birr Castle were 1850–75. By the turn of the century the telescope had fallen into disuse, and in 1914 the mirror was presented to the science museum in London, where it is still on display. The remainder of the telescope—the massive wooden tube, the universal joint, and the protecting walls—can still be seen on the grounds of Birr Castle. This is now the home of the sixth earl of Rosse, who takes a keen interest in his astronomical forebears and is currently constructing a museum at the site of the "Leviathan." Even in this age of sophisticated scientific instrumentation, a trip to Birr Castle is an interesting pilgrimage and tribute to one of the greatest telescope builders of the last century. ☐

Share the Thrills of Exploring Outer Space!

$229.95 f.o.b. Hartford, Conn.

$15 Crating Charge

All DYNASCOPES, including this superb RV-6, 6-inch available on easy terms!

Now it's easy to join the thousands of serious amateurs who have discovered the excitement of exploring our mysterious universe. Your enjoyment begins right from the start, yet the challenges and rewards go on for years! And it's a hobby that can be shared at modest cost.

Choose From Many DYNASCOPES®

Picking a telescope to fit your needs and your pocketbook is simple when you select a DYNASCOPE—the same instruments used by more than 150 schools, colleges and observatories—and your satisfaction is guaranteed by a full-refund warranty.

FASCINATING GUIDE YOURS FREE!

Read these valuable facts before buying any telescope. Mail coupon or postcard for your complimentary copy of this helpful guide.

Criterion Manufacturing Co.
620 Oakwood Ave., W. Hartford, Conn. 06110

® TM Registered U.S. Pat. Office

CRITERION MANUFACTURING CO., Dept. NH-52
620 Oakwood Ave., W. Hartford, Conn. 06110
Please send your free Telescope Guide.

Name____________________

Address____________________

City____________State________

JEWELRY LIFE SIZE
BC-8 Byzantine Cross
EY-1 Sacred Eye Ring
(Ancient Egyption Doctor's Amulet)
AP-5 ANKH PENDANT 2½" long

Ancient Jewelry Replicas
In 14 Karat Gold & Sterling Silver

		Sterling Silver	14K. Gold
AP-5	Ankh Pendant 24" ch.	$32.50	$119.50
BC-8	Byzantine Cr. 24" ch.	35.00	125.00
EY-1	Sacred Eye Ring	29.50	119.50

Rings sized to 11½ no extra cost. • Money back guarantee. Add $1.50 for insured postage. • Orders shipped promptly. • Bankamericard & M.C. for orders $50. minimum.

COLLECTOR'S CATALOG . . . picturing relics from ancient worlds—BC to AD. Plus special Jewelry Catalog showing ancient replicas in precious metals. Both catalogs—50¢. . . . Free With Order!

VISIT GALLERY—APPT. ONLY—CALL CI 6 0793

aladdin house, ltd.
Dept. NJ1174 • 648 Ninth Ave. • N.Y. 10036

SOLID 24K. GOLD JEWELRY AVAILABLE—PRICE ON REQUEST

©NATIONAL GEOGRAPHIC SOCIETY

I want to give Natural History for Christmas

Enter my gift (a one-year Associate Membership in The American Museum of Natural History and 10 issues of Natural History magazine) for the people listed below. **Bill me later at $8 for the first gift, $7 for each additional gift.**

SEND GIFT TO: ☐ NEW ☐ RENEWAL

NAME

ADDRESS

CITY STATE ZIP

SIGN GIFT CARD FROM:

SEND GIFT TO: ☐ NEW ☐ RENEWAL

NAME

ADDRESS

CITY STATE ZIP

SIGN GIFT CARD FROM:

MY NAME

ADDRESS

CITY STATE ZIP

And That's Not All

With their membership and subscription, my friends will also receive two bonus books (special members' editions); free admission to the Museum; use of the Members' Reception Lounge and a discount in the Museum Shop.

NATURAL HISTORY

Outside U.S.A., please add $2.00 per year for postage. J128

FIRST CLASS
PERMIT NO. 4946
DES MOINES, IOWA

BUSINESS REPLY MAIL

No Postage Stamp Necessary if Mailed in the United States

POSTAGE WILL BE PAID BY—

NATURAL HISTORY
P. O. Box 5000
Des Moines, Iowa 50306

by Ronald Singer

Epitaph for a Fossil Hunter

By the Evidence, by L.S.B. Leakey. *Harcourt Brace Jovanovich, Inc., $9.95: 276 pp., illus.*

It has been stated that all biological research undertaken since the publication of Darwin's *Origin of Species* (1859) constitutes merely a commentary on his conclusions. At the time, Darwin hoped that "light would be thrown on the origin of man and his history." Although his *Descent of Man and Selection in Relation to Sex* first appeared in 1871, Darwin had been collecting data for this volume since 1838. In this latter year, a French customs official and amateur archeologist, Boucher de Perthes, confirmed the slowly developing and flamingly controversial nineteenth-century concept that man may have had a prediluvial (pre-Noachian Flood) origin. In very ancient gravels of the Somme, near Abbeville, he discovered flints worked by "antediluvian" man.

Thus it was little more than a century ago that the climate of opinion began warming toward the acceptance of the concept of evolution. On rather scanty evidence Darwin concluded in 1871, as did Ernst Haeckel at the same time in Germany, that man evolved physically from some apelike or monkeylike ancestors. Such a birthplace was pinpointed as a hot country, probably Africa, and the time of origin as somewhere between the Eocene and Miocene (between 54 million and 26 million years ago).

Steadily increasing discoveries of fossil remains throughout the world during the past hundred years have built up overwhelmingly convincing documentation of the common ancestry of man and his fellow primates. The idea of *a* "missing link" has gone by the board as a host of missing links have been unearthed and dozens of other gaps in the chain of events have become obvious. Included among the fundamental questions remaining are: which are the most likely direct (hominid) ancestors and which conceived the idea of shaping a stick, bone, or stone as a tool for use in an imagined future eventuality? The attempts to elucidate this conceptualization and the unique social behavior of man have only recently led to the remarkable explosion of studies dealing with primate behavior. Furthermore, attempts to crystallize the sequences in primate evolution have led to new investigative approaches, such as biochemical analysis of albumin and other blood elements and statistical analyses, using sophisticated mathematics and computers, of structural functions in primate locomotor adaptations.

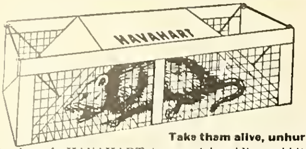
Since 1924, when anatomist Raymond Dart recognized the first australopithecine ("southern ape") in South Africa, there has been a great surge of interest in comparative functional anatomy of primates. (For many years most of his colleagues refused to accept this as a stage, or link, between apes and man.) Further discoveries by the South Africans—Broom, Robinson, and Dart—of the remains of more than a hundred australopithecine individuals and the Leakey family's dramatic recovery since 1959 of datable remains in East Africa focused considerable attention on this group of hominids, probably to the detriment of studies on other aspects of human evolution. Thus support has again arisen for Darwin's hypothesis of an African "cradle" of mankind, but surely the evidence only highlights the fact that most investigators have zeroed in on African deposits and that few have concentrated their efforts in other parts of the world, notably Asia, where suggestive evidence of another "cradle" already exists. Also, national and international strife over several decades in Asia has discouraged interest in field work there.

Controversy has always been a feature of science; in fact, development and progress hinge on the necessity for disbelief, reassessment, and inquiry. So the appearance of one more controversial figure on the horizon of human evolutionary investigation is no surprise.

Louis (pronounced Lewis) Leakey was born in 1903 at Kabete, near Nairobi, Kenya. He died on October 1, 1972, one day after he completed writing *By the Evidence*, the second volume of his autobiography, which covers the period 1932–51. The first volume, *White African*, written at the surprisingly early age of thirty, was published in 1937. The major part of his remarkable career was spent in an indefatigable hunt for fossils in East Africa, and his efforts placed Kenya and Tanzania on the map of prehistory. Born of missionary parents, Leakey displayed a tireless zeal for converting people to interests close to his heart, including prehistory, building a national museum, respecting the status and culture of the Kikuyu tribe (into which he had been initiated at the age of thirteen), wildlife conservation, and breeding dogs.

He took his undergraduate degree at St. John's College, Cambridge, majoring in anthropology and archeology. In 1924, while still an undergraduate, he collected fossil reptiles in Tanzania (then Tanganyika) as a member of the British

CATCH ANIMAL RAIDERS!



Take them alive, unhurt!

Simple, safe HAVAHART traps catch raiding rabbits, possums, coons, squirrels, pigeons, sparrows, etc., without injury. Straying pets, poultry released unhurt. Fully assembled. No jaws or springs to break. Galvanized; many in use 20 years. Open ends give animal confidence. Sizes for all needs. Send 25c (credited to first order) for valuable illustrated guide and price list.

HAVAHART, 158 Water St., Ossining, N. Y. 10562

Please send new guide and price list.

Name ____________________

Address ____________________ Zip ________

WEEKENDS IN THE

WILDERNESS

Adirondack, High Peaks, Catskills.
Instruction in mountaineering,
survival, backpacking
On foot, snowshoes, skis, in canoes.
Also 9 to 13 day Concentrated Courses.
Write for Fall, Winter, Spring schedule H.
North American Wilderness Survival School
205 Lorraine Avenue, Upper Montclair,
N.J. 07043. Tel: (201) 783-7711

NATURE ON STAMPS

The BIRDS & the BEES & the ANIMAL KINGDOM
on GENUINE POSTAGE STAMPS.

* SAMPLES & APPROVALS—$1
Satisfaction Guaranteed

Mil Med Stamps
P.O. BOX 297-NN AURORA, CO. 80010

EVERYONE'S FAVORITE GLASS

From its beautiful bird in flight across an Aegean blue sky, to its classic tip-proof base, this 11 oz. blown glass is a timeless treasure. A perfect gift for any occasion — or a bit of self indulgence for anyone who enjoys beautiful things. Dishwasher proof, of course. Set of 8 $15.00, set of 12 $21.00, postpaid in U.S.A. Add $3.00 West of Rockies or air delivery. Credit card phone oders accepted. Allow 10-14 days for delivery. Add $1.00 for subscription to Landfall Collection catalogue.

THE LANDFALL COLLECTION
138-A Water St., S. Norwalk, Conn. 06856
Our 28th Year 203-838-5581

Museum East African Expedition. By 1935 he had led four archeological research "expeditions" in East Africa (while holding a fellowship at Cambridge); on the third excursion he discovered stone tools at Olduvai for the first time. He had also excavated at Gamble's Cave, Lake Nakuru, and Lake Naivasha in Kenya. Although his academic training was relatively limited, the wealth of his field experience became immense. His excavations of, and observations on, former lake levels and stone implements discovered on various terraces led to the development of his concepts on past climatic fluctuations. Eventually, tying his ideas to the observations of Dr. Wayland of Uganda, he charted four pluvial (wet) periods interspaced by interpluvial (dry) periods in the East Africa Pleistocene, which he related to the European geochronology. These delineations were accepted (and untested) for a long time, but later geologists involved in East African Quaternary research dropped this scheme.

Leakey was a man of many facets. His close contact with Kikuyu tribesmen during his formative years gave him a mastery of their language and deep knowledge of their culture. Later, during World War II he served in the Nairobi Criminal Investigation Department, where he studied calligraphy and assisted in solving crimes. He was a dedicated wildlife conservationist and a lover of pets and other animals; above all he was a naturalist and an explorer of fossil deposits.

When I reviewed (in *American Biology Teacher*, April, 1968) the reprinted edition of *White African*, I ended the review, "However, the story of his second 'thirty years' would certainly be more stimulating and exciting reading, because his boundless energy has produced some great contributions to our knowledge of man's prehistory." Anticipating that the new memoirs would contain stimulating insights into his research, scientific thinking, and philosophy, I found *By the Evidence* somewhat disappointing and reminiscent of so many accounts of life in "dark Africa." Each chapter describes about one year of the 1932–51 period of his life, and occasionally one gets the impression that he was laboring to fill a chapter. It certainly is a personal account, as stated by the pub-

Who's Who in Indian Relics

A 400 page directory of amateur archaeologists and collectors with over 750 photographs of some of the finest private collections in North America. A must for every Collector. $15.00 Postpaid.

BEN THOMPSON
1228 W. Essex
St. Louis, Mo. 63122

Money back, if not entirely satisfied.

WHEN YOU WRITE TO NATURAL HISTORY

about a change of address, renewal of subscription, billing, or any kind of adjustment, send the present address label from the magazine wrapper.

Moving? Please notify 6 weeks in advance.
You can use this form to tell us about a move or order a subscription.

Change of address—attach your address label in the dotted area and fill in your new address below, clip and mail to: Natural History Magazine. Membership Services, Box 6000, Des Moines, Iowa 50306.

A new subscription—Check box and fill in name and address below.

☐ 1 year—$8
☐ 2 years—$15
☐ 3 years—$21

(Add $2 per year
to Canada and other
non-U.S. orders)

Cut your old address label from magazine
wrapper and attach over this area.
Fill in your NEW address below and mail to:
Natural History Magazine
Membership Services Box 6000
Des Moines, Iowa 50306

H001

PLEASE PRINT

Name ____________________

New Address ____________________

City ____________ State ________ Zip ________ lishers, but some of it is trifling and inconsequential. Quite a large section contains Perry Mason-type stories of his escapades with Superintendent Poppy of the Nairobi CID, in which Leakey usually comes out the hero.

Yet, those who knew him or know of him will be fascinated by parts of this autobiography. Olduvai Gorge, with which the names Mary and Louis Leakey will forever be linked, was discovered (for science) in 1911 by the German entomologist Kattwinkel. Before World War I, fossilized animal bones had been collected there by Hans Reck of Berlin. In 1913 the Germans' interest in Reck's discoveries was heightened by his recovery of a human skeleton (Oldowan man) in an apparently Middle Pleistocene context. Leakey describes his examination of the site in 1931 (in the company of Reck), which seemed to confirm Reck's claim that the place where he had found the obviously sapient skeleton was in undisturbed deposits of Bed II (contradicting Leakey's statement in 1929 in *The Stone Age Cultures of Kenya Colony* that the skeleton was "almost certainly . . . not contemporary with the fossil deposits of the gorge in which it was found" and suggested that it was an intrusive burial). This would not be the last time that his hypotheses and the facts became contradictory. In 1933, however, Leakey (together with his newly discovered and controversial Kanam and Kanjera fragments) visited Mollison in Munich, examined Reck's Olduvai skull, and became convinced of its relatively recent age, thus vindicating his earlier hypothesis. Of course, this tied in with his *Homo sapiens* diagnosis of the Kanam mandible to which he ascribed a Middle Pleistocene age, astounding his colleagues. Leakey also deals extensively with his Kanam and Kanjera discoveries and the disbelief expressed by the influential British geologist Boswell, and his colleagues, of Leakey's claim to the fossils' age. Leakey admits his inability to show Boswell the exact spot of recovery, and whose side one takes in the as yet unsettled dispute remains a matter of opinion. I personally believe that Boswell's incredulity plagued Leakey all his life and contributed to his unceasing efforts to make new discoveries. On the other side of the coin, however, is an aspect of Leakey's life noted in the publisher's prologue: "For although the outstanding importance of his fossil discoveries is universally acclaimed, Leakey's own interpretation of them is not. It is to his credit that this fact never embittered him."

For the younger scholars who study Leakey's recent publications on Olduvai Gorge, there must be some mystery in the apparently peculiar way he designated and cataloged the various gullies and sites where he collected fossils for thirty years. For example, one of the richest sites was designated FLK in 1931, the letters representing Frida Leakey Korongo. (Korongo is an African word for gully, or eroded trench, and Frida was Leakey's first wife.) Here, thirty years later, his second wife, Mary, discovered the first remains of *Zinjanthropus*. In 1935, he designated another gully MNK (Mary Nicol Korongo, after the maiden name of his future second wife, who began doing drawings for his book *Adam's Ancestors* in 1933), in which remains of so-called *Homo habilis* were eventually discovered; while in LLK (named after himself) the so-called Chellean man (*Homo erectus*) was discovered.

He provides brief insights into his personal married life—the divorce from Frida and his devotion to, and respect for, Mary. With pride he points to the recent important discoveries of his son Richard, who is following in his father's footsteps as the intrepid, skilled fossil hunter.

Like many other scientists, Leakey had difficulty finding funds for his research work and also for his personal needs. Fortune occasionally smiled upon him as, for example, in 1936 when he was offered a two-year research grant and salary by the Rhodes Trust to undertake a detailed study of the Kikuyu. He provides a fascinating account of the thoroughness with which he undertook the study, essentially extensive oral reports from the tribesmen of their beliefs, customs, and traditions. The final draft of his report, which ran to nearly a million words, was not published in his lifetime, but fortunately, his wife is now editing it for publication.

Leakey pays constant tribute to Mary Leakey, who undertook exca-

ENJOY
Wildlife
THE INTERNATIONAL WILDLIFE MAGAZINE FROM BRITAIN EVERY MONTH. FORMERLY ANIMALS, BUT NOW RENAMED AND BETTER THAN EVER.

Wildlife
THE INTERNATIONAL WILDLIFE MAGAZINE

The wild animals and plants of every land, discussed by the world's top naturalists and conservationists. Lavishly illustrated with full colour photography. Advisory board includes Sir Julian Huxley, Alan Moorehead, Roger Tory Peterson, Edwin Way Teale, and Nobel Prize-winner Niko Tinbergen.

If you already enjoy "Natural History" you'll find **Wildlife** the perfect complement.

Roger Tory Peterson says: "Other natural history magazines have their merits, but I especially enjoy **Wildlife** because it is so specific, telling me new and interesting things about the animal kingdom."

Annual subscription $12.00 – or only $11.00 if you send cash with order.

Wildlife Magazine,
133 E. 55 St, NY, NY 10022.
Please enter 12 mos subscription for
Name
Address
City State Zip
☐ I enclose $11.00 ☐ Bill me for $12.00

EAST AFRICA FIELD TRIPS
Auspices of the Sierra Club

Leisurely field trips under informative leadership. Three-week tours by car. Longer, more extensive tours by private plane.

YOU'LL LIVE IN THE WILDERNESS right among the animals . . . elephants, hippos, rhinos. The hoofed beasts: zebra, giraffe, impala, wildebeeste, buffalo and others. The predators: lion, leopard, cheetah plus smaller hunters. More birds than you ever imagined.

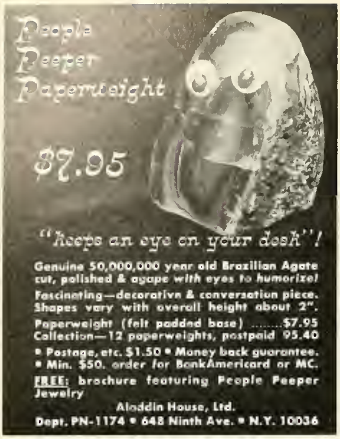
YOU'LL SEE the whole magnificent land from the snows of Mt. Kenya and Kilimanjaro to the beaches of the Indian Ocean . . . tribesmen as natural and exotic as the wildlife . . . white settlers . . . Asians in turbans or saris . . . veiled Moslem women . . . the ethnic struggle . . . tribalism vs. nationalism . . . agriculture vs. conservation . . . progress vs. prehistoric folkways.

YOU'LL BE COMFORTABLE. Room and bath at delightful lodges—uncrowded cars—everyone has body room and a window seat—new luxurious five passenger 2-engine planes—leisurely pace—frequently two nights in the same place.

For brochure, see your travel agent or write to:

Sierra Club (212) 354-1480
East Africa Field Trips
c/o Club Tours, Inc.
Dept. NH 11, 25 West 43 St., N.Y., N.Y. 10036
Please send your East Africa brochure to
Name
Address
City State Zip
I am interested in departures in (month)

Tours are organized and operated by Club Tours, Inc.


People Peeper Paperweight

$7.95

"keeps an eye on your desk"!

Genuine 50,000,000 year old Brazilian Agate cut, polished & agape with eyes to humorize!

Fascinating—decorativn & conversation piece. Shapes vary with overall height about 2".

Paperweight (felt padded base) $7.95
Collection—12 paperweights, postpaid 95.40

• Postage, etc. $1.50 • Money back guarantee.
• Min. $50. order for BankAmericard or MC.

FREE: brochure featuring People Peeper Jewelry

Aladdin House, Ltd.
Dept. PN-1174 • 648 Ninth Ave. • N.Y. 10036

DROLL YANKEES HUMMINGBIRD FEEDER has 3 feeding stations, a three year guarantee, and is simple, strong & easy to clean. $8.25 postpaid. Write for free catalog of our bird feeders & bird song phonorecords.

DROLL YANKEES® INC., Box 98-N
Foster, Rhode Island 02825
Telephone orders: 401/647-2727

CRUISE INLAND FLORIDA

Relax 5 days on the Lazy Bones plus airboat and swamp buggy jaunts in Everglades country, $187 complete. Mid-Dec. thru April. Featured on Jack Douglas TV series. For brochure and reservations write:

Capt. Stan Maurer SHANTY BOAT CRUISES
Box 366D, Fort Myers, Florida 33902

BOOK HUNTING?

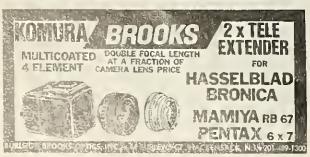
Virtually any book located—no matter how old or long out-of-print. Fiction, nonfiction. All authors, subjects. Name the book—we'll find it! (Title alone is sufficient.) Inquire, please. Write: Dept. 65.

BOOKS-ON-FILE
UNION CITY, NEW JERSEY 07087

FREE INFORMATION

WRITE TODAY to find out how you can receive a different, interesting and valuable Mineral Specimen each month, with detailed "come-alive" fact sheet. Get started today in this fascinating and educational hobby. FREE Natural Ruby Crystal when you join. Write today!

MINERAL OF THE MONTH CLUB
P.O. Box 487-HG Yucaipa, Calif. 92399


KOMURA BROOKS 2 x TELE EXTENDER

MULTICOATED 4 ELEMENT

DOUBLE FOCAL LENGTH AT A FRACTION OF CAMERA LENS PRICE

FOR HASSELBLAD BRONICA MAMIYA RB 67 PENTAX 6 x 7

BURLEIGH BROOKS OPTICS, INC. [illegible] HACKENSACK, N.J. 201-489-1300

vation of many of the sites discovered. With continual diversion of his interests throughout his career, it is surprising that Leakey did not call on his many colleagues—archeologists and geologists—to undertake or assist in excavating the numerous sites he discovered but seldom excavated thoroughly, especially considering the importance of obtaining accurate geologic interpretation of the sites. It was really only after the discovery of the "Zinj" skull in 1959 that "outside" collaborators were invited.

Leakey highlights in his book the problems of transportation and field work in East Africa. Because of the difficulties of obtaining water in the Olduvai Gorge, he was occasionally forced to use a rhino-spoiled waterhole. With a certain nonchalance he portrays the sweat, tears, and laughter involved in fossil hunting and archeological excavating under trying conditions. His extensive observations on African wildlife are revealed in interesting snippets about various animals he encountered. He describes with pride his part in the development of a wildlife preserve (now the Nairobi National Park) unencumbered by government officialdom but entrusted to an independent board in 1946. He recounts stories about Italian prisoners of war captured in Ethiopia at the beginning of World War II and, in particular, their participation in the building of the open-air museum at the remarkable Olorgesailie site with its thousands of Acheulean stone tools. He spends much time on his adventures as a handwriting expert and "sleuth" in the Nairobi CID, and in many of the cases his imagination and keen observation stood him in good stead.

The account of his numerous visits over many years to the Miocene sites on Rusinga Island in Lake Victoria—at first by dhow and later by motorboat—provide a warm background touch to the important discoveries of the dryopithecine (*Proconsul*) apelike remains. Although he refers to his collaboration with Sir Wilfrid le Gros Clark on the publication of the earlier observations, it is in these accounts that I would have wished for more details of his thoughts on the controversial issues.

The chapters dealing with his preparations for, and organization of, the First Pan-African Congress of Prehistory in Nairobi in 1947 constitute interesting historical documentation. He recalls serious and amusing incidents that provide titillating sidelights on notable personalities in prehistoric studies. He ends this volume with a note about the Second Congress in 1951: scheduled to be held in South Africa in 1947, it had to be canceled because of the new government's rigorous apartheid policy and was transferred to Algiers.

This book contains a fairly lengthy publisher's prologue and an epilogue in which aspects of Leakey's varied and energetic career are accented. They make reference to his many discoveries, his extensive influence, and his personality. Although they mention his controversial nature, they only compound confusion by "taking sides" in some of the scientific harangues. These issues should be left for scientists and history to decide. Leakey's influence was pervasive and notable, and his discoveries of such importance that he does not need vindication or reinforcement from his publisher, no matter how well motivated the latter may be. From this source it smacks too much of publicity, rather than recognition of scientific merit.

By the Evidence conveys the thoughts, ideas, and *Weltanschauung* of a great and pioneering prehistorian and fossil hunter. One easily detects in these pages Leakey's effervescent enthusiasm, missionarylike zeal, singular energy, multifaceted personality, stubbornness, and determination. In and between the lines one can read his character and true self, and different people will analyze these differently: his admirers and his critics will not recognize the same traits, but that only reflects his life.

> The heights by great men
> reached and kept
> Were not attained by
> sudden flight,
> But they, while their companions slept,
> Were toiling upward in
> the night.
>
> LONGFELLOW,
> "The Ladder of St. Augustine"

Ronald Singer is the Robert R. Bensley Professor in Biology and Medical Sciences and chairman of the Department of Anatomy at the University of Chicago.

IN THE HUMAN INTEREST, by Lester R. Brown. *W. W. Norton & Co., $6.95; 190 pp.*

In the Human Interest is an important new book, both as a superb, concise summary of the critical state of the human food system and as a call for specific action to salvage it. Ironically, in publishing such a straightforward account of the world situation, Brown, a former official of the Agency for International Development and now a Senior Fellow at the Overseas Development Council, may endanger his credibility with the planet's numerous technological Pollyannas. Such is the price of honesty. In our strange world, physicians who diagnose critical illnesses and prescribe cures are rarely labeled pessimists. Yet, when a well-informed, previously optimistic, agricultural economist like Brown joins the ranks of the ecologists, systems analysts, and others who have concluded that the human species is breeding, plundering, and polluting itself to the brink of disaster, he runs the risk of being dismissed as just another doomsayer. We hope instead that Brown's book is read, understood, and used as an outline for action all over the world.

For *In the Human Interest* is one of the most accurate and up-to-date reviews in print of the state of the planet. Written in part for delegates to the United Nations World Population Conference, it connects population growth with worldwide ecological and economic conditions and the limited availability of food, energy, and water supplies necessary to sustain *Homo sapiens*.

After tracing a brief history of population growth, Brown debunks the myth that technological breakthroughs in agriculture and energy generation will allow us to farm the deserts and feed the starving billions. He outlines many of the constraints that make massive famines likely: burgeoning population growth, increased affluence, unpredictable weather, the inability of plant scientists to coax higher yields from soybeans, the steady decline of ocean fish catches, and the disappearance of fertile land not already under cultivation. He does not discuss some of the most serious ecological threats associated with agriculture, nor does he stress the critical problem of the decay of genetic variability in our crops. But considering his intended audience this may have been a wise decision. Politicians, at the United Nations or elsewhere, are not likely to read a long book.

Having outlined the case for population control, Brown then takes an extremely controversial stand on the maximum size to which the population should be limited. He argues convincingly that the population must be stabilized at just below six billion, half the number that U.N. demographers consider "most likely." Other people have recognized that demographers consider fertility, mortality, and growth rates in a vacuum and fail to assess the availability of the resources necessary to sustain the numbers of people they project. These people do not take the U.N. projections seriously, simply assuming that great rises in the death rate will occur to halt population growth by the early part of the next century. But Brown, as far as we know, is the first informed person to propose that growth can be halted, without another doubling, by lowering birthrates. His plan for stabilizing world population is comprehensive yet conservative. He calls for increased government family planning activity, expansion of contraceptive delivery through commercial channels, changes in the role of women to de-emphasize childbearing and rearing, and improvements in health care and social security programs—all as inducements to lower birthrates. He cites hopeful birthrate trends in both overdeveloped and underdeveloped countries, which indicate the job could be done. We suspect he is overoptimistic, but the attempt is certainly worth the effort, for any progress made in lowering birthrates will tend to limit rises in death rates.

Brown's plan for reversing the trend to what he terms "superaffluence" in developed countries is much less specific, although acknowledged as equally necessary as curbing population growth. Reducing energy consumption by reducing the use of automobiles and the consumption of meat by wealthy and middle-income people is a solid first step, according to Brown, since a mere 10 percent drop in U.S. beef consumption could free tens of millions of tons of grain for starving people in poorer countries. In addition, he suggests increasing the amounts of loans and aid to poorer countries that emphasize labor-intensive (rather than energy-consumptive) economic, social, and agricultural development, in order to reduce unemployment and increase food supplies and financial reserves.

The alternatives are clear, according to Brown. We must either embark on crash programs in population control and social and agricultural development both here and abroad or soon suffer "one of the great discontinuities of human history." The world's people have little time left to wonder which it will be.

PAUL R. EHRLICH
and
PAUL J. GROWALD
Stanford University

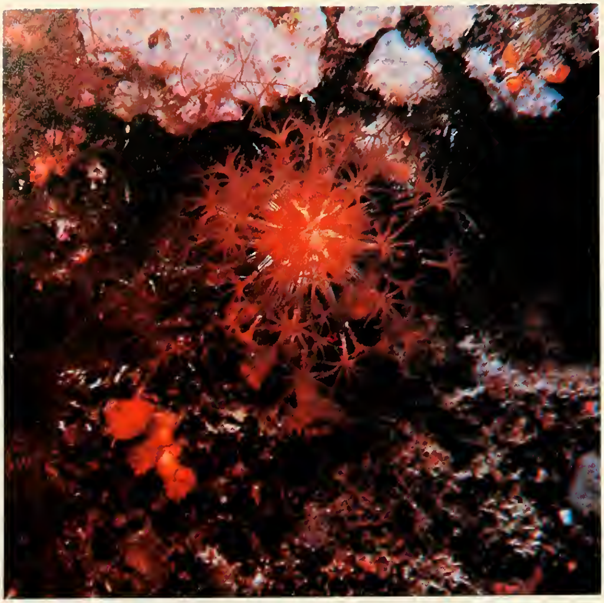
Belau Archipelago revealed through the lens of a camera

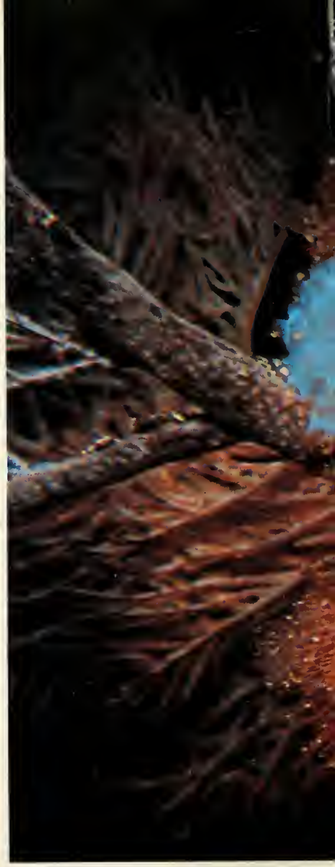
THIS LIVING REEF, by Douglas Faulkner. *Quadrangle/The New York Times Book Co., $22.50; 179 pp., illus.*

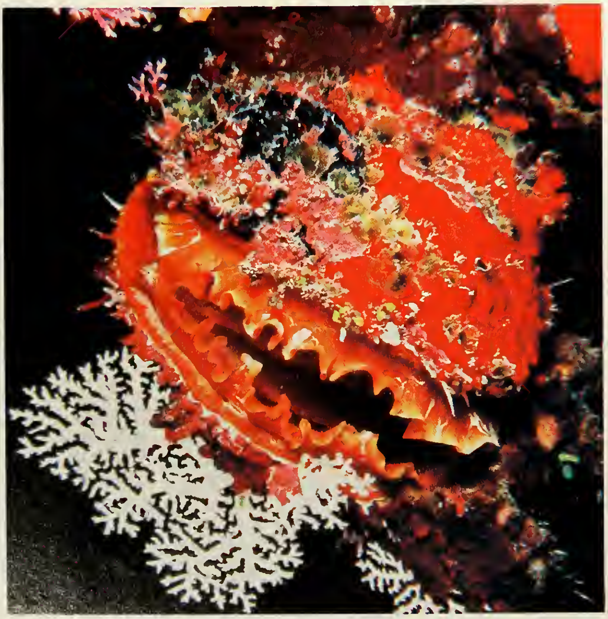
Douglas Faulkner ought to take a lesson from his camera. In his hands it has taken exquisite portraits of a coral reef—without comment, interpretation, or moral judgment. Not so his text, which is a hard sell for experiencing a mind-expanding appreciation of life's deepest mysteries. Unfortunately, what an archipelago of incredible beauty did for Faulkner, Faulkner's prose will not do for us. His photographs have a better chance.

Some seven years ago Faulkner discovered the Belauan archipelago, an isolated string of volcanic islands and coral reefs in the western Pacific. Captivated by their natural charm and serenity, he made five trips to the islands in as many years and investigated and photographed the entire range of marine environments that exists there. He dove off outer reefs that slope into the deep ocean, swam through shallow passes and lagoons, poked along the islands' coves and inlets, and lugged his camera and aqualung into the jungle to examine the curious marine lakes that are connected to the

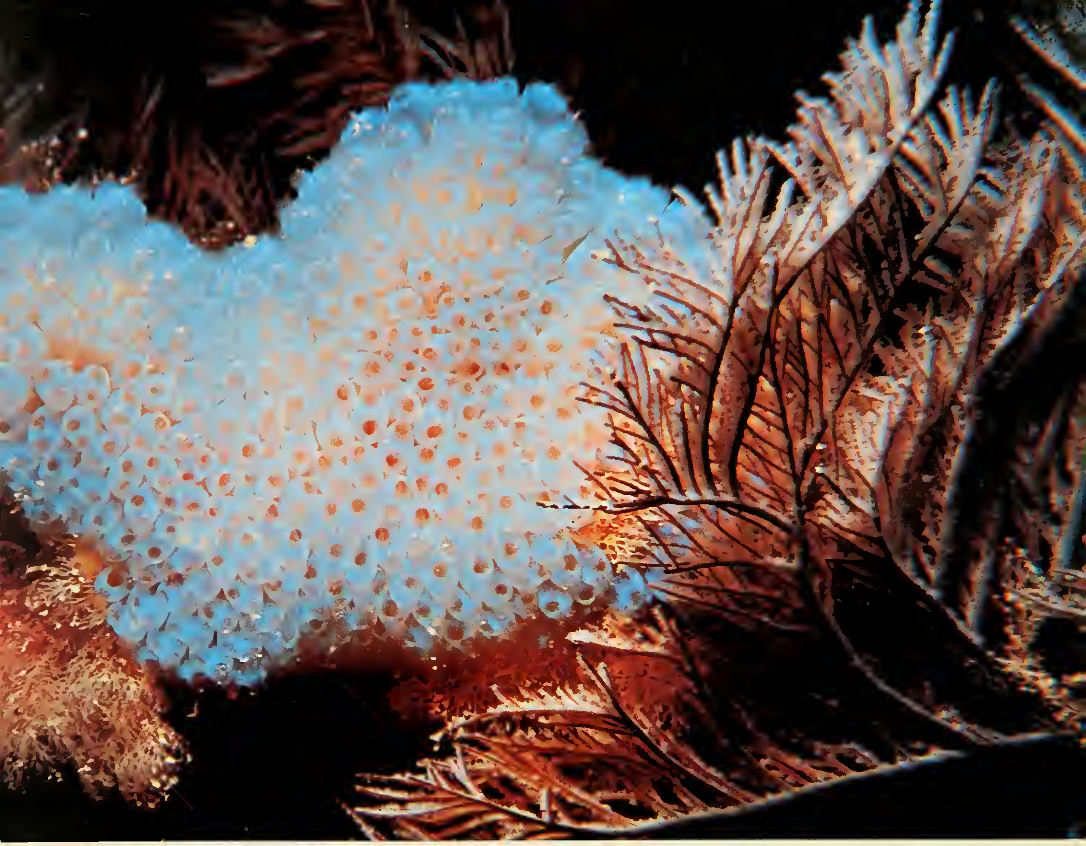
Dandelion coral



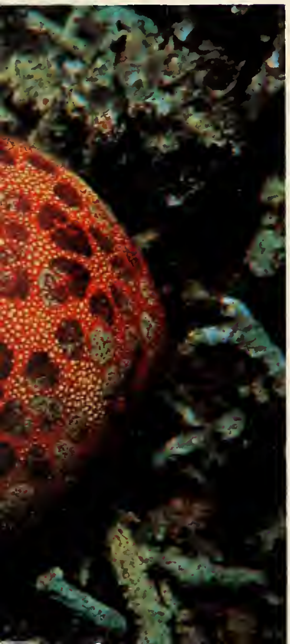




Thorny oyster



Tropic Sky ascidians on black coral



sea only by underground channels.

The result of his survey is *This Living Reef.* The slim volume contains 107 photographs, preceded by some 30 pages of text and followed by brief explanations of the plates. The book opens with a delightfully grisly legend of the islands' genesis, then goes on to rambling descriptions of the islands themselves and to more or less scientific explanations of their creation and evolution. Throughout the text there is an uncomfortable mixing of science, poetry, and ingenuous moralizing. Do the earth's restless tectonic plates really "creak"? And does a coconut "gamble to reenact what was rehearsed and coded in its genes"?

The scientific content of the book is as accurate and complete as it need be for a work of this kind and suffers only from the usual problems that occur when a nonscientist tries to generalize and drastically abbreviate information he only partially understands. The subject's outline is generally true, but its complexities and contradictions get trampled underfoot.

Faulkner states emphatically that the realms of science, poetry, and philosophy have never seemed mutually exclusive to him. He is determined to combine the three. Facts, he says, "aren't alive for us unless transmuted through poetry and philosophy as expressions of our encounter with the world that surrounds us." It is an ambitious attempt, and until the author illustrates how consistently scientific explanations can obstruct the flow of a narrative or how completely the anthropomorphizing of the natural world can deflate the impressive neutrality of science, one is not fully aware of the difficulties of wedding the three realms.

The text ends with an account of a day's work—a hard, sweaty climb

Pincushion sea star

Skunk clownfish amid sea anemones

through the jungle into a perfectly hidden marine lake. At last the author is working with his own observations, and the slippery rocks, steep, overgrown trail, and menacing darkness of the jungle have a refreshing immediacy that is broken only occasionally by detours into heavy life-death-me-thee-and-the-jellyfish philosophizing.

The photographs, which make up the major portion of the book, are divided into four sections: the outer reefs, the passes, the lagoons, and the coves and marine lakes. Here Faulkner's talent shines. Wide panoramic views of the islands and reef flats orient the viewer as he is led into a world of incredible splendor. There are fish with gaping jaws, coral communities as colorful as a stained glass window, and a composition of a silver crinoid with red sea whips as starkly abstract as a modern painting. The range of colors, subjects, and feelings is remarkable, and Faulkner wisely places his explanations—combinations of scientific identification and personal observation—at the end of the book, where they will not detract from the impact of the photographs. The plates are truly beautiful, and happily, we are allowed to respond to them as we are able.

Susan Schlee

Announcing the first space magazine written to be understood...

Popular Astronomy: A new magazine. A special offer.

Explore the world around you,
and the worlds beyond . . . . .

It's true that men have been walking on the moon for years. Yet, for the non-scientist, no single publication has been available to explain, in non-scientific terms, the mysteries of the space we've begun to explore.

POPULAR ASTRONOMY MAGAZINE IS GOING TO CHANGE ALL THAT

Each month, *Popular Astronomy* will unravel hundreds of awesome facts about the stars, planets and galaxies that surround us. In language that novice, hobbyist and amateur scientist alike, can understand.

Leading experts in the fields of astronomy and space technology will bring you up to date on the latest developments in their specialties, and provide you with hours of entertaining reading at the same time.

STUNNING COLOR PHOTOGRAPHY BRINGS THE BEAUTIES OF THE UNIVERSE INTO YOUR HOME

Unlike other astronomy publications designed specifically for the professional scientist, the feature articles in *Popular Astronomy* will be superbly illustrated. And, as an added bonus, each issue will contain a full color center spread you will want to collect and treasure. A grouping of these striking photographs will make a unique conversation piece for a recreation room or den . . . and identify you as an individual in pursuit of knowledge and understanding.

POPULAR ASTRONOMY PREVIEWS

In the months ahead, you'll read articles that deal with . . . **A star-by-star tour of the evening sky.** Discover which planets are visible to the naked eye at certain times of the year, and the many other wonders that can be revealed with the use of binoculars or a small telescope.

Build-you-own telescope projects. Educational and lots of fun! Step by step illustrations insure success, even for the beginner.

Celestial Events. Up-to-the minute reminders of solar and lunar eclipses, meteor showers, occultations and other sky shows you can observe from your locale.

Product Reviews. Offer objective analyses of optical and astronomical equipment, where you can get it, and what you can expect to pay for it.

Club news and travel notes. You'll get reports of upcoming observation expeditions, openings of new planetariums, and the formation of astronomy groups in your locale.

If you've ever been the least bit curious about what exists in the skies above, you'll find *Popular Astronomy* an irresistible magazine. And, if you take advantage of this exceptional introductory subscription offer, you'll be automatically enrolled in the Galaxy Discount Society, compliments of *Popular Astronomy.*

SPECIAL CHARTER MEMBERSHIP OFFER

The first issue of *Popular Astronomy* will be published early this spring. If you subscribe now, you can save 1/3 off the regular price of $15.00 for twelve issues. You save $5.00 and are assured the lowest subscription rate when you renew. You will also receive a free membership for **Galaxy Discount Society**, which entitles you to attractive savings (a minimum of 10 per cent) on astronomical books, star maps and equipment of all types.

Popular Astronomy Magazine
245 East 25th Street - New York, N.Y. 10010

Yes, please enter my subscription. My check (or money order) for $10.00 is enclosed. I understand that I will become a charter subscriber, and that I will be entitled to a minimum discount of 10 per cent on astronomical supplies as a member of the Galaxy Discount Society. I also understand that you will refund my subscription at any time if I am not pleased with Popular Astronomy Magazine.

NAME ______________________________

ADDRESS ______________________________

CITY ____________ STATE ________ ZIP. ________

☐ Please enter ________ gift subscription(s) and send special gift announcement card(s) with my name. I enclose a separate sheet of paper listing name(s) and address(es) of recipient(s).

69NH

Celestial Events

by Thomas D. Nicholson

Sun and Moon. The sun moves from Libra in early November, through Lupus and Ophiucus, and into Sagittarius by mid-December; this takes it progressively farther south of the equatorial plane. And with its southerly motion, the sun spends less and less time above the horizon in the Northern Hemisphere. Although the shortest day of the year doesn't come until late December, the earliest sunset of the year occurs on December 10 or 11 at the mid-latitudes of the United States.

After new moon on November 13, the early crescent should be visible in evening skies by the 16th. First-quarter moon is on November 21; full moon on November 29. Thereafter, the moon is in the morning sky, rising later than sundown and remaining in the sky past dawn. Last-quarter moon occurs on December 6; new moon again on December 13.

Partial Solar Eclipse. A partial eclipse of the sun occurs on December 13, visible throughout the United States (except Alaska and Hawaii), eastern and central Canada, and Mexico. The eclipse will take place during the morning hours, beginning about an hour before noon (standard time) along the eastern seaboard, progressively earlier to the west. In the mountain and Pacific states and in western Canada, the sun rises partially eclipsed. Duration will be nearly three hours along the east coast, where more than half the sun's diameter will be covered at mid-eclipse.

Stars and Planets. Jupiter and Saturn appear on our star map this month. Jupiter is in Aquarius, well up toward the south at dusk, setting about midnight; Saturn is in Gemini, rising in the early evening before Pollux and Castor and remaining in the sky till dawn. Venus is an evening star, but sets too early to be seen. Mercury and Mars are in the morning sky, but they rise too late to be seen before dawn.

The Leonid meteor shower reaches maximum on November 17, the Geminid shower on December 14, with no moonlight in the morning skies on either occasion. The Leonids normally produce up to fifteen shower meteors per hour, some very bright; the Geminids are not noted for their brightness, but a patient observer may see as many as fifty meteors per hour.

November 17: Leonid meteor shower reaches maximum.

November 21: Moon is at apogee, farthest from earth.

November 22: Jupiter is near the moon this evening.

November 24: Mercury is in conjunction with Mars.

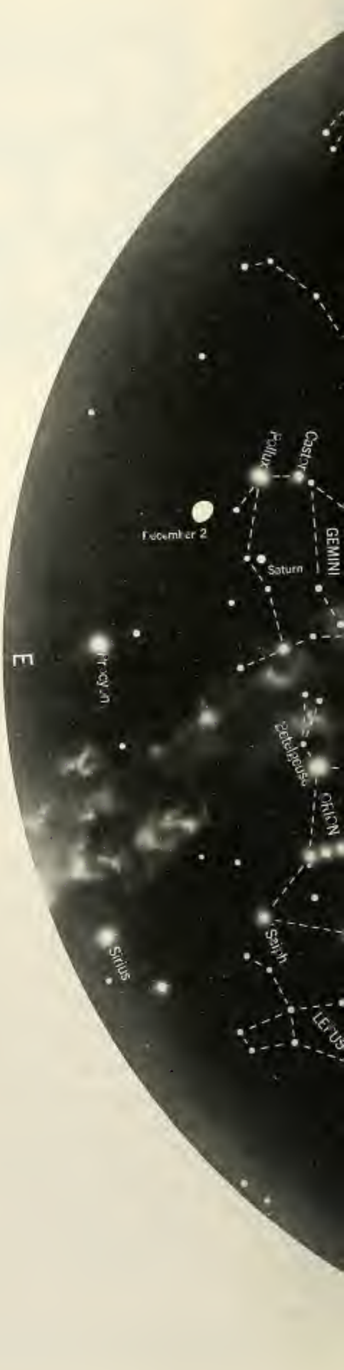
November 29: A total lunar eclipse occurs, after moonset in most of the continental United States, and at least partly visible in Alaska, Hawaii, and in northwestern Canada.

December 1–2: Saturn is near the moon from moonrise, shortly after dark, until dawn.

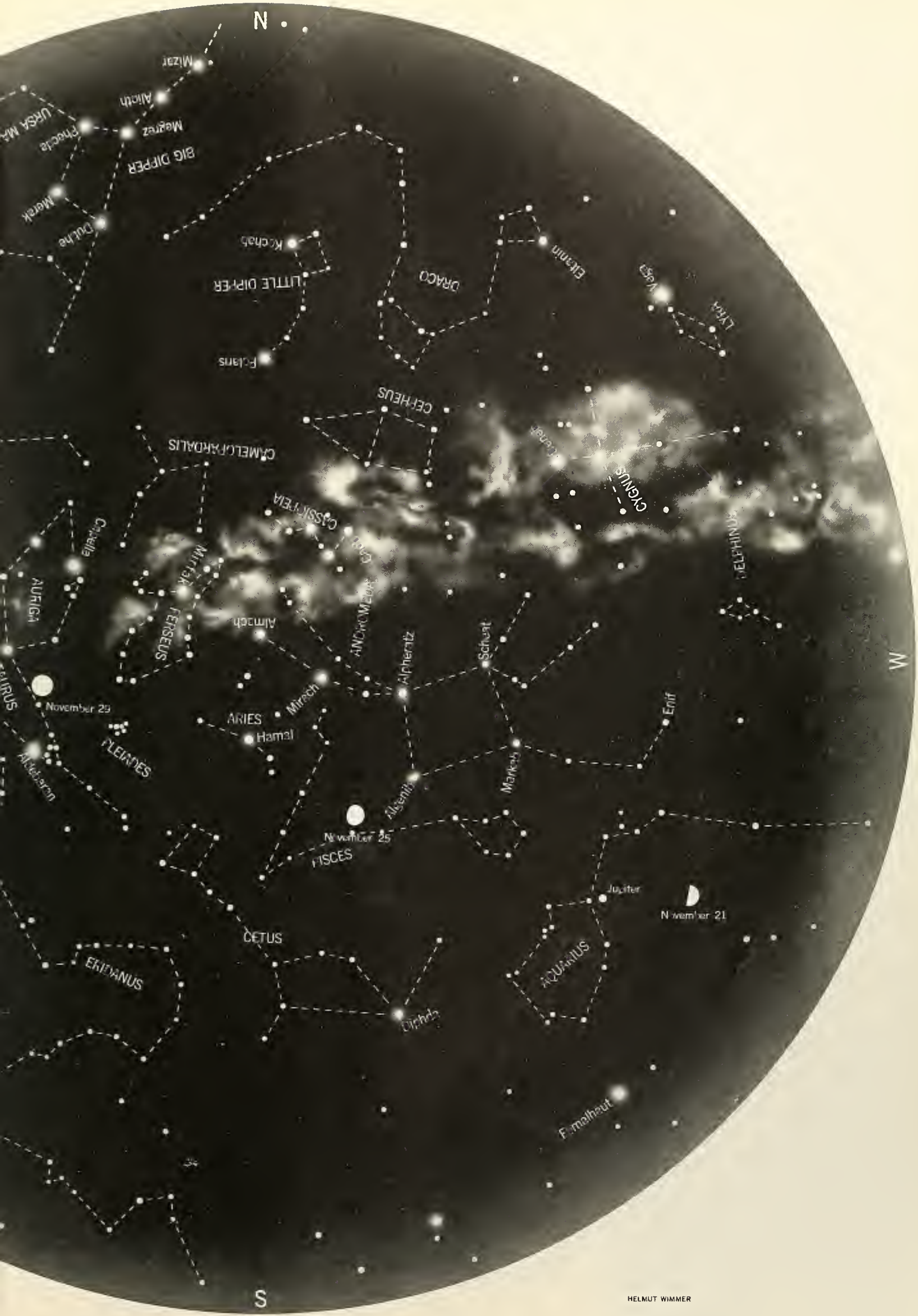
December 3: Moon is at perigee, nearest the earth.

December 13: Partial solar eclipse, visible throughout North America.

December 14: Geminid meteor shower reaches maximum.



★ Hold the Star Map so the compass direction you face is at the bottom, then match the stars in the lower half of the map with those in the sky near the horizon. The map is for 10:20 P.M. on November 15; 9:20 P.M. on November 30; and 8:20 P.M. on December 15; but it can be used for about an hour before and after these times.


N
Mizar
Alioth
Megrez
Phecda
URSA MA
BIG DIPPER
Merak
Dubhe
Kochab
LITTLE DIPPER
Polaris
DRACO
Eltanin
Vega
LYRA
CEPHEUS
CAMELOPARDALIS
Deneb
CYGNUS
CASSIOPEIA
Capella
AURIGA
Mirfak
PERSEUS
Almach
ANDROMEDA
DELPHINUS
W
Alpheratz
Scheat
Mirach
ARIES
Hamal
November 29
PLEIADES
Aldebaran
Enif
Markab
Algenib
November 25
PISCES
Jupiter
November 21
CETUS
ERIDANUS
AQUARIUS
Diphda
Fomalhaut
S

HELMUT WIMMER

Island of Saints . . .
Continued from page 69

those that are not. Anecdotes are the most popular of all folklore forms and are far more humorous than legends. One typical anecdote concerns piloting, or navigating. Only one pilot remains on the island, but early in the century men of several families guided vessels through the sound south of Inis Beag to ports on the mainland. The man who still plies the trade seldom contacts likely customers now, and what with modern charts and navigating instruments, more often than not his services are refused once he rows out to a ship. But piloting is still very much alive in people's memories, and they relate many tales of real and imagined humorous experiences of pilots. One of these concerns a fishing crew that was hailed by the captain of a passing schooner. Although not a pilot, an aged member of the crew claimed that he was and climbed aboard. The captain agreed to hire him when he said that he knew the coastline well. Soon after, the ship struck bottom "with a great bump," and the enraged captain shouted, "I thought you said you knew all the rocks in the sound," to which the islander quietly replied, "I did, and that's one of them."

The true joke is foreign to Inis Beag, and the word *joke*, used both in English and the vernacular, refers to the brief and climactic humorous anecdote. One such joke tells of a Church of Ireland pastor on a nearby island who gave the men working for him the day off on All Saints' Day; ten days later when they asked to be off once again on Saint Martin's Day, he inquired with seeming pique, "And where was Martin on All Saints' Day?"

Outsiders, particularly visiting Irish-Americans and young men on vacation from jobs in England, are responsible for introducing true jokes in recent years. But the islanders rarely repeat these, especially if they are "dirty." Because of sexual repression, there is no indigenous "dirty anecdote" tradition. I had some success telling true jokes, but most that I knew had to be modified. One in particular became widely disseminated and had to do with a dog who, in the original version, urinated into a glass of beer being drunk by a man who had previously abused the animal; the penultimate line in the revised joke became, "Do you know your dog stuck his tail in my pint (of stout)?" To which the dog's owner, a piano player in the pub, replied, "No, but whistle it and I'll play it by ear."

The folk of Inis Beag, like other peasants of the Gaeltacht, commonly employ proverbs when speaking Irish, but rarely do so if using English. The islanders' adroit use of proverbs is a mark of erudition and elegance of speech; proverbs are employed to add color and give point, to guide, to encourage, to praise, to admonish, to reprove, and to implement the art of indirection so dear to the Irish. Proverbs and tales provide models of proper behavior for children. Many are so subtle as to be meaningless without an understanding of the history and culture of Inis Beag and Ireland. "Come raise the bag on me"—a tragic yet humorous example—derives from the days of the famine, when maize was distributed to the poor and hungry. Given a one-pound sack, an old woman with eight mouths to feed asked an official to help her place the "great load" on her back. Now, "come raise the bag on me" is used whenever someone receives less than he anticipated.

Word play, combined with such personality traits as secretiveness, envy, jealousy, and feelings of inferiority, makes Inis Beag one of the most difficult of human societies in which to do ethnographic research. In her book *Mind You, I've Said Nothing*, Honor Tracy admits that fact finding in Ireland is a precarious occupation: facts are "rarely allowed to spoil the sweep and flow of conversation," and the Irishman "soars above their uninviting surfaces on wings of fancy"; he is a man "of honeyed words, anxious to flatter and soothe, cajole and caress"; he finds "an innocent glee in misleading and deceiving for its own sake," and for him, "obfuscation is the rule."

The use by islanders of wings of fancy, honeyed words, and obfuscation—popularly known as "blarney"—reflects an archaic tradition of verbal wit. Blarney, a vital component of Irish charm, is often the product of a delicately poised set of defense mechanisms that can serve to shield genuine thoughts and feelings, thereby protecting the ego.

These conditions led us to devise some unorthodox research techniques, the most valuable of which was the composition of a 62-verse ballad in the folk idiom. It was inspired by a shipwreck and rescue that we participated in on March 8, 1960. This singular experience and its fascinating aftermath enabled us to gain insights into the culture that would have been difficult, if not impossible, to obtain under ordinary circumstances of research. Three weeks after the rescue, I was urged to turn balladist and compose a song dwelling on the humorous aspects of the event and of incidents that had occurred in the interim, many of them involving the disposition of "salvaged" Vat 69 Scotch whisky, a major portion of the general cargo. (For years after, whisky galore was to be found in our tight little island.) The request was prompted by the absence of a local composer, some spontaneous rhyming I had done in the pubs, and an article in a Dublin newspaper about the rescue written by my wife but attributed to me (reflecting conceptions of the division of labor in Inis Beag). I decided to comply with the wishes of my fellow imbibers, chose the air of the popular broadside "Brian O'Linn," and copied the lyric style of its author.

I based as many verses as possible on the more prevalent, and no doubt more distorted, rumors that were circulating. Reprehensible Brian O'Linn was assigned various roles—captain of the ship, lighthouse keeper, guard, priest, king, tourist, and customs official, among others—and eventually I arranged the stanzas in chronological sequence, dealing with episodes from the entry of the vessel into the south sound at dawn on the day of the wreck to what might transpire in the years to come.

If the ballad persists, it will gradually become more of a folklore than a "fakelore" product, as it is molded by successive singers. If, however, it eventually dies out, it will still be carried for at least one term by my students—that is, by those who wish to earn a passing grade—until I retire. All that can be said in 1974 is that, for more than a dozen years, its singing and recitation by islanders and students have provided *scléip* on both sides of the Atlantic. ☐

Announcements

This month the **Museum Shop** of The American Museum of Natural History in New York moves into newly renovated and enlarged quarters. A collection of Eskimo sculpture is featured. The additional wall space in the new shop allows hangings, prints, and posters to be displayed more effectively and in greater number than before. The jewelry department has also been expanded, and visitors will have an even wider range of items to choose from.

Museum member-subscribers get a 15 percent discount on books and a 10 percent discount on all other purchases in the shop.

Gallery 77's new exhibit, "Puppets: Dance + Drama of the Orient," opens November 13. This showing of the Museum's extensive collection of shadow puppets from the East will feature oriental theatrical music and continuous screenings of films from India, China, and Thailand.

Museum botanist Helmut Schiller will give two talks this month. The first, a slide lecture scheduled for Tuesday, November 12 at 2:00 P.M. in Education Hall, is entitled **"Population Ecology: The Limiting Factors,"** and will deal with the subtle behavioral factors that affect population ecology, and why these often overlooked factors can be more significant than the obvious ones like food and predation.

On Thursday, November 21, at 2:00 P.M., Schiller will give a gallery talk on **"North American Forests."** The discussion will cover the various kinds of forests in North America, where they occur, and why their occurrence is limited; how people manage—and mismanage—the land; and what constitutes "good forestry." Gallery talks assemble at the First Floor Main Information Desk.

Both talks are part of the Fall 1974 Education Department series now in progress. All gallery talks and slide lectures are free to Museum visitors. To obtain a complete fall schedule of programs, write to the Education Department in The American Museum of Natural History.

"Culture and Adornment in Africa," a two-week-long special presentation by the Education Department, will get under way on Saturday, November 30 and Sunday, December 1, with performances by guest artists in the main auditorium at 2:00 P.M. The program will continue in the People Center from December 2 through December 13 with teaching demonstrations and displays. For further information write to the Coordinator of African-American Studies in the Education Department of the Museum.

Christopher J. Schuberth of the Education Department will lead a **Weekend Field Trip in Urban Geology** on April 26 and April 27, 1975. The group will travel through eastern Pennsylvania and New Jersey and will identify the major geologic provinces in the region. Fossil and mineral specimens will be collected and studied. The area is noted for its great variety; there are about six major geologic provinces within its narrow geographic boundary.

The field trip is limited to 35 persons, with advance reservations accepted. For information about this and other events, you may write to the Eduction Department or telephone (212) 873-7507.

On November 26, a new **Sky Show** begins at the American Museum-Hayden Planetarium. "A Midnight Clear" studies the winter sky, as it appears now and as it looked 2,000 years ago, and questions the astronomical nature of the "Star of Christmas."

Sky Shows begin at 2:00 and 3:30 P.M. during the week, with more frequent showings on weekends. Admission is $1.75 for adults, and $1.00 for children.

The Most Liqueur
Irish Mist
Liqueur

HEATHER HONEY.
A BEAUTIFUL IDEA FOR
A LIQUEUR.

For over 700 years we've been taking the sweetest, most natural thing on earth and making it part of a fine liqueur. Imported Irish Mist.®

We use just a touch of pure heather honey. So it doesn't sweeten, it mellows Irish Mist's deep rich taste.

Discover what a beautiful idea it is.

Antique jeweled bee. James Robinson, Inc., N.Y.
Imported Irish Mist® Liqueur. 80 proof.
©1974 Heublein, Inc., Hartford, Conn., U.S.A.

LIVE IN THE WORLD OF TOMORROW . . . TODAY!

And our FREE 164 PAGE CATALOG is packed with exciting and unusual values in ecological and physical science items — plus 4,500 finds for fun, study or profit . . . for every member of the family.

A BETTER LIFE STARTS HERE

ACTUAL WORKING SOLAR HOME PLANS

Learn all about the most fascinating possible home of the future. It can be your "now" answer to today's energy crisis in housing. Expert Dr. Harry E. Thomason tells advantages, problems, savings, and more in this important 20-pg fact-filled booklet. Also includes 8-page oversize insert of basic, actual solar home plans, a valuable guideline to you and your architect in fitting space requirements, design ideas, and local area building codes.

No. 9440E....(Solar House Plans)..$10.00 Ppd.

● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ●

PRO ELECTRONIC SOUND CATCHER

Parabolic mike w/18¾" reflecting shield & 2 I.C.'s in amplifier magnifies signals 100X that of omni-directional mikes. Catch a songbird ½ mile off; QB's huddle strategy; sounds never before heard. Super directivity gives highest signal to noise ratio poss. Safe auto. cuts off ear damaging noises. Earphones, tape recorder output, tripod socket. Req. two 9v trans. batt. (not incl).

No. 1649E....(5½LB.)..$299.00 Ppd.
BIG EAR "TOY" MODEL #80,176E..$32.25 Ppd.

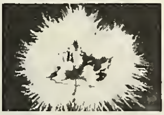
● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ●

MYSTERY OF ENERGY AND AGING

Science fact or farce? Can our Great Pyramid unlock the mysteries of energy & aging — show that the ancient Egyptians contradicted nature? Did someone really get 85 shaves from a blade kept in a pyramid? Test claims like meat not rotting, things not rusting! Users of exact scale models of Cheop's pyramid oriented to true North claim all sorts of strange phenomena based on resonating energy. Ours is already assembled, ⅛" see-thru acrylic, 6 x 9¼ x 9¼".

Stock No. 71,817E..$20.00 Ppd.

● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ●



NEW! KIRLIAN PHOTOGRAPHY KIT!

Experiment in the fascinating new field of "Kirlian electrophotography—images obtained on film without camera or lens by direct recording of electric charge transmitted by animate & inanimate objects." Each "aura" differs—animate aura said to change corresponding to physical changes. Kit incls portable darkroom, double transformer isolated from power source; instrs.

Stock No. 71,938E..$49.95 Ppd.
"HIGH VOLTAGE PHOTOGRAPHY" by H. S. Dakin
No. 9129E....(60-PG. PPBK BK.)..$5.00 Ppd.

3" ASTRONOMICAL REFLECTING TELESCOPE

See stars, moon, planets close-up! 30 to 90X. Famous Mt. Palomar Type. Aluminized & overcoated 3" diameter f/10 primary mirror, ventilated cell. Fork type equatorial mount. Durable PVC tube. Includes 1" F.L. 30X Ramsden, Barlow lens to triple power, 3X finder telescope, hardwood tripod. FREE: "STAR CHART", "HOW TO USE" book

Stock No. 85,240E..$ 49.95 Ppd.
DELUXE 3" REFLECTOR TELESCOPE....#80,162E........................$ 79.95 Ppd.
4¼" REFLECTOR (45X to 135X)....#85,105E........................$149.50 FOB
6" REFLECTOR (48X to 360X)....#85,187E........................$249.50 FOB

● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ●

KNOW YOUR ALPHA FROM THETA!

For greater relaxation, concentration, listen to your Alpha-Theta brainwaves. Ultra-sensitive electrode headband slips on/off in seconds—eliminates need for messy creams, etc. Atch'd to amplifier, filters brainwaves, signals beep for ea. Alpha or Theta wave passed. Monitoring button simulates Alpha sound; audio & visual (L.E.D.) feedback. Reliable, easy-to-use unit comparable to costlier models. Completely safe. Comprehensive instruction booklet.

No. 1635E....(8x3x4"; 24 oz.)..$134.50 Ppd.
LOW COST "Starter" UNIT,
No. 71,809E..$55.00 Ppd.

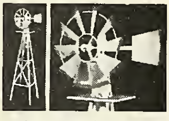
● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ●

ERECT A "PRO" WEATHER STATION

Match your forecasting skill with anyone! Set up permanent meterology sta. for reliable readings: windspeed, precipitation, barometric pressure, temp., humidity; get wind-chill, cloud types. Top qual. equipt.: rooftop remote reading pneumatic windspeed ind.; 11" rain guage; holosteric barometer (inches, etc.); hi-lo self register thermometer; wet-dry bulb hygrometer. More!

No. 80,216E....(w/372 PG. LOG)..$69.50 Ppd.
BEGINNER'S KIT: COMPL., LOW COST
Stock No. 71,022E..$18.95 Ppd.

● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ●



AUTHENTIC SCALED WINDMILLS

Real-thing replicas show wind direction, wheel silently revolves on ball bearings. Give your grounds unique rural charm! Great centerpiece for planter, flowers. Use to hold yard light, house number, sign or as mailbox. For school, a fine "energy crisis" science project — does everything but pump water. Heavy gauge steel, durable outdoor finish; aluminum color w/red trim.

No. 71,923E....(17" DESK MODEL)..$10.95 Ppd.
4½ FOOT—14 LB.....No. 71,924E..$32.50 Ppd.
8 FOOT—46 LB.....No. 85,229E..$44.95 FOB

● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ●

GREAT INT'L. PAPER PLANE BOOK!

Official fly-them-yourself book of paper airplanes from *SCIENTIFIC AMERICAN'S* "1st International Competition". Includes plans of all winning entries, time-aloft records, photos, technical data, commentaries. Has 20 unusual designs on perforated pages for easy tear-out. You won't believe how some of them fly! Amusing, entertaining. 128 pages, 9"x11¾".

Stock No. 9391E..$2.95 Ppd.

MAIL COUPON FOR GIANT FREE CATALOG!

164 PAGES • MORE THAN **4500 UNUSUAL BARGAINS**

Completely new Catalog. Packed with huge selection of telescopes, microscopes, binoculars, magnets, magnifiers, prisms, photo components, ecology and Unique Lighting items, parts, kits, accessories — many hard-to-get surplus bargains. 100's of charts, illustrations. For hobbyists, experimenters, schools, industry.

EDMUND SCIENTIFIC CO.
300 Edscorp Building, Barrington, N. J. 08007

Please rush Free Giant Catalog "E"

Name________________________________

Address______________________________

City______________State__________Zip__________

COMPLETE & MAIL WITH CHECK OR M.O.

☐ PLEASE SEND GIANT FREE CATALOG "E"

30 DAY MONEY-BACK GUARANTEE
YOU MUST BE SATISFIED OR RETURN ANY PURCHASE IN 30 DAYS FOR FULL REFUND

EDMUND SCIENTIFIC CO. 300 Edscorp Building, Barrington, N.J. 08007

How Many	Stock No.	Description	Price Each	Total

Add Handling Chg : $1.00, Orders Under $5.00, 50¢, Orders Over $5.00 ______

TOTAL $ ______

I enclose ☐ check ☐ money order for $__________

NAME________________________________

ADDRESS______________________________

CITY______________STATE__________ZIP__________

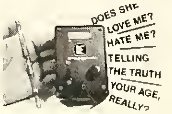
"POP" YOUR OWN BUTTONS

Make customized badges in minutes! Create your own, reproduce photos with name affixed. Great anywhere, from kindergarten to business meetings, to school sports. Sell for profit! Ingenious badge machine makes permanent buttons; kit includes precision cast hand die press, matching color dies, starter asst. for 25 complete badges including plastic protectors. Sold nationally for several dollars each, yours will pay off fast. Step-by-step instrs.

Stock No. 71,974E...$31.50 Ppd.

● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ●

LIE DETECTOR TYPE METER



Amazing Emotion Meter reveals hidden likes, dislikes. Easy to use; sensitive, accurate. Measures changes in body resistance caused by changes in emotional state. Needle movement indicates emotional response (not whether favorable or unfavorable). Effectiveness depends on questions asked and interpretation. Unique 10-oz. set ideal for entertainment and education — parties, science projects, psychological experiments. Requires 9V transistor battery (not included). Instructions.

No. 42,194E....(2⅞ x 4 x 1¾")...$19.95 Ppd.

● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ●

STARTS SEEDS IN 3 TO 5 DAYS!

New thermostatically controlled electric greenhouse provides constant 70° growing temperature, accelerates seed germination, helps produce healthy thriving plants ready for outdoor planting. Big 3 sq. ft. planting area—29" x 15" x 4" box holds ½ bushel of growing medium. Germinates tomato seeds in 3-5 days; asters, dahlias, petunias, wk. or less. Incl. 3" x 4" ft. clear plastic cover, supports. Uses reg. home current.

Stock No. 80,153E...$16.95 Ppd.

● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ●

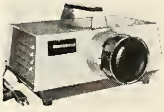
TAKE TEMPERATURES IN *SECONDS*

Edmund's new *electronic* oral thermometer obsoletes glass mercury type. *Seconds* instead of minutes, more *accurate*, much *easier* to read! Put disposable cover (supply incl.) on flexible probe, place under tongue, push button, dial meter center, read temp fast in F.° & C.°. 92-106°F. (33-41°C.) in ¼° increments, 97-101°F. to 1/10°. Safe, hygienic, no squinting. Compact metal case fits in doctors', nurses' shirt pocket. Incls 9v trans batt., instrs.

Stock No. 42,210E...$25.00 Ppd.

● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ●

BIG 6 x 6" OPAQUE PROJECTOR!



Great buy! New lightweight compact enlarges any picture or print matter (up to 6 x 6") for big projection 30 to 144" away. True color reproduction! Feat.: optically polished *glass* lenses, heat-resist. plate glass mirror, curl-free slide tray, heavy duty motor, large fan. Just put two 200w household bulbs (not incl) inside its steel body, plug in 8' cord, place copy in slide tray. You can't beat it under $100! 13 x 13½ x 7¾"

Stock No. 80,217E....(9 LB.)...$69.95 Ppd.

DELUXE 5 x 5" OPAQUE PROJECTOR

No. 71,272E....(SUPER SHARP)...$129.00 Ppd.

● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ●

50-150-300 POWER MICROSCOPE

Amazing Value—3 Achromatic Objective Lenses on Revolving Turret! Color-corrected, cemented achromatic lenses in objectives give far superior results to single lenses usually found in this microscope price range. Results are worth the difference! Fine rack and pinion focusing. Imported!

Stock No. 70,008E...$45.00 Ppd.

MOUNTED 500 POWER OBJECTIVE:

Threaded achromatic lenses, 3mm F.L.

Stock No. 30,197E...$7.75 Ppd.

LIVE IN THE WORLD OF TOMORROW . . . TODAY!

And our FREE 164 PAGE CATALOG is packed with exciting and unusual values in ecological and physical science items — plus 4,500 finds for fun, study or profit . . . for every member of the family.

A BETTER LIFE STARTS HERE

NEW BINOCULAR-TO-CAMERA HOLDER

Fits any camera for exciting telephoto pictures. 35-mm camera with 7 x 50 binocular brings distant object 7 times nearer. Ideal for long-range photos of wild life, ships, people, planes, etc. Attaches easily. Use any binocular or monocular—and camera—still or movie, color or black & white. Gray crinkle and bright chrome finish. 10" long. Full directions.

Stock No. 70,223E...$17.95 Ppd.

● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ●

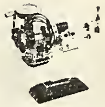
QUALITY DETECTOR UNDER $40

New Edmund developed, fully transistorized BFO unit capable of locating quarter at 18"—powerful 6 trans. oscillator-amplifier circuit. Easily compares to others priced 50% higher! Aluminum pole and housing—not plastic! 6" waterproof search coil (Faraday shielded to elim outside interference); long 50 hr battery (9V) life; powerful 2" speaker; 1-knob on-off tune control Perfect balance; lightweight (2 lb). Great buy!

Stock No. 80,222E...$39.95 Ppd.

● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ●

AMAZING NEW WANKEL ENGINE KIT!



Build your own see-through motorized model of revolutionary pistonless type engine, rights for which GM recently paid $50 million and may be a '75 Vega option. Only one considered modifiable to meet new standards. Replaces piston, cylinder, crank assemblies with rotating discs (sections removed for firing chambers). Smaller than conventional; fewer parts, greater reliability, same speed w/less horsepower. Switch. Reg. 2—1.5V batt. (not inc.).

No. 71,424E....(4½" x 5" x 9")...$7.95 Ppd.

519 Pg "Wankel" BOOK—#9439E...$15.25 Ppd.

● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ●

CAN'T SLEEP, RELAX? TRY THIS!

Electronic sound conditioner simulates 4 kinds of soothing sounds of ocean surf and rain. "White sound" helps mask unwanted noise, adds restful, intriguing background sound. Program the solid-state unit to your own need: 2 surf, 2 rain; or "white sound", proven by medical tests to have analgesic effects. Great for meditation, restlessness, sleeplessness psychology.

(A) No. 71,997E....(7½ x 7 x 3½") 110V AC...$79.95 Ppd.

(B) AS ABOVE, BUT "WHITE SOUND" ONLY

No. 71,980E....(6" Rd. x 3½" Hi)...$28.00 Ppd.

● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ●

"FISH" WITH A MAGNET

Go treasure hunting on the bottom! Fascinating fun & sometimes profitable! Tie a line to our powerful new specially designed 150 lb. pull Magnet—drop it overboard in bay, river, lake or ocean. Troll it along bottom—your "treasured" haul can be outboard motors, anchors, other metal valuables. Has 6 stacked ceramic magnets. Lifts more than 150 lbs. under water!

No. 71,135E....(3¼ x 3⅞")...$17.50 Ppd.

75-LB. PULL (1 LB.) W/3 CERAMIC MAGNETS

No. 71,150E....(1 11/16 x 3¼")...$11.00 Ppd.

USE COUPON ON OTHER PAGE TO ORDER & GET GIANT FREE CATALOG

EDMUND SCIENTIFIC CO.

TELEPHONE: 609-547-3488
300 EDSCORP BLDG.
BARRINGTON, NEW JERSEY 08007

ORDER BY STOCK NUMBER • SEND CHECK OR MONEY ORDER
MONEY-BACK GUARANTEE

Additional Reading

MAINE'S HUNTERS (Page 14)

INTRODUCTION TO AMERICAN ARCHEOLOGY, vol. 1. G. R. Willey. Prentice-Hall, Englewood Cliffs, 1966.

PREHISTORY OF NORTH AMERICA. J. D. Jennings. McGraw-Hill Book Company, New York, 1968.

ARCHAIC INDIAN CEMETERY IN NEWFOUNDLAND. J. A. Tuck. *Scientific American*, June, 1970.

GRACEFUL WEASELS (Page 44)

MAMMALS OF WISCONSIN. H. H. Jackson. University of Wisconsin Press, Madison, 1961.

MAMMALS OF THE WORLD. E. P. Walker. The Johns Hopkins University Press, Baltimore, 1968.

MAMMALOGY. T. A. Vaughan. W. B. Saunders Company, Philadelphia, 1972.

AMERICAN WEASELS. E. R. Hall. University of Kansas Publications, Lawrence, 1951.

THE APPALACHIANS (Page 52)

NIGHT COMES TO THE CUMBERLANDS. H. M. Caudill. Little, Brown and Company, Boston, 1963.

AMERICA THE RAPED. G. Marine. Simon and Schuster, Inc., New York, 1969.

SURFACE MINING AND OUR ENVIRONMENT. U. S. Department of the Interior, Washington, 1967.

SAINTS . . . AND SCLÉIP (Page 62)

THE IRISH COUNTRYMAN. C. M. Arensberg. Doubleday and Company, Inc., New York, 1968.

THE PERSONALITY OF IRELAND. E. E. Evans. Cambridge University Press, New York, 1973.

INISHKILLANE. H. Brody. Schocken Books, Inc., New York, 1973.

GOLA. F. H. A. Aalen and H. Brody. The Mercier Press, Ltd., Cork, 1969.

INTESTINAL ECOLOGY (Page 70)

LIFE ON MAN. T. Rosebury. The Viking Press, Inc., New York, 1969.

ANTONY VAN LEEUWENHOEK AND HIS LITTLE ANIMALS. A. van Leeuwenhoek. C. Dobell, tr., Dover Publications, Inc., New York, 1932.

IRISH TELESCOPE (Page 98)

MESSIER'S NEBULA AND STAR CLUSTERS. K. G. Jones. American Elsevier Publishing Company, Inc., New York, 1969.

FRONTIERS IN ASTRONOMY. O. Gingerich, ed. W. H. Freeman and Company, Publishers, San Francisco, 1970.

THE GIFTS OF MOTHER EARTH
FROM THE
COLLECTOR'S CABINET
DEPT. NH, 1000 MADISON AVENUE, NEW YORK, N.Y. 10021

VISIT OUR TREASURE HOUSE OF NATURAL HISTORY OR SEND 50¢ FOR OUR FULL-COLOR "MOTHER EARTH CATALOG"

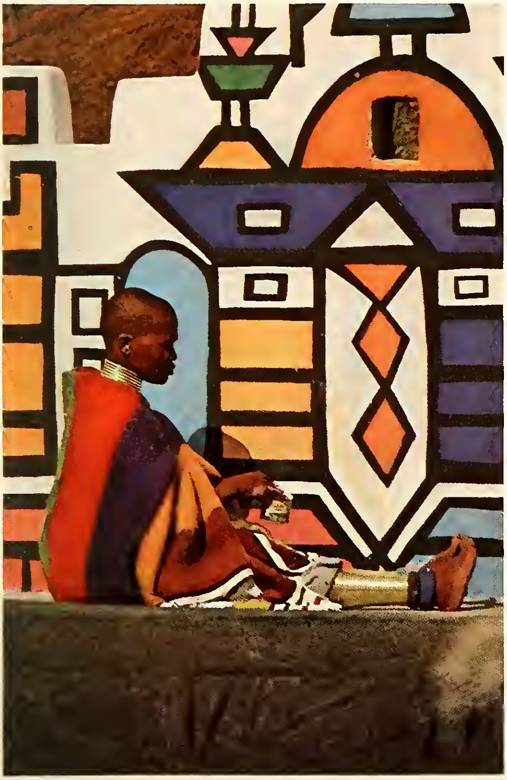
Branches: Chadds Ford, Pa., Dania, Fla., Miami Beach, Fla., Portland, Ore., Springfield, Va., Syracuse, N.Y., Washington, D.C.

Also at Bloomingdale's, Davison's, Foley's, Sanger-Harris, Strawbridge & Clothier, Woodward & Lothrop and 50 other fine dept. stores nationwide Write for the store nearest you.

Top row BUTTERFLY METAL SHADOW BOX with bright orange Malaysian Appias Nero and brilliant iridescent blue Brazilian Morpho Aega. 6¼" x 8¼". *$12.50.* BUTTERFLY PLAQUE with blue and black Brazilian Morpho Achilles. 7½". *$10.00.* Center row JUMBO OSTRICH EGG from South Africa. 5" to 6" With Lucite stand *$15.00* WILDFLOWER FRAME with Orange Cosmos from Utah. 5⅛" x 7¼". *$8.50.* THE FABLED CHAMBERED NAUTILUS from the Philippines. 6" to 8". *$5.00.* (Add *$3.00* for Lucite "[illegible]" easel as illustrated.) PEARLED NAUTILUS from the Philippines. 6" to 8". *$7.50.* (Add *$3.00* for Lucite stand, as illustrated.) COLORFUL SEA-URCHIN from the English Channel. Orange or purple 4" to 4½". *$7.50.* (Add *$2.00* for Lucite holder.) Bottom row MAN-EATING PIRANHA from the Brazilian Amazon. About 6" [illegible] WHITE CLUSTER CORAL from the Philippines. 5" to 7". *$5.00.* SHEAFFER PEN on BRAZILIAN AGATE BASE. 4" to 6". *$15.00.* FOSSIL FERNS, 280 to 310 MILLION YEARS OLD. From the coal beds of Pennsylvania. Plaque about 4" to 5". *$5.00.* Plaque about 7" to 8". *$10.00.* (Add *$2.50* for Lucite easel.) PICTURE MARBLE from [illegible] Miniature mountains with natural scenes. Height about 6". *$15.00.*
Minimum mail order *$10.00.* Add 10% for postage and handling. Include applicable sales taxes. No overseas orders. Satisfaction guaranteed 5-day return privilege

Come to South Africa and...

look at our art, or look at our art.



The women artists of the N'debele village have created abstract, geometric murals on the walls of their houses with masterly precision. There's something about the broad, bold strokes and bright, rich colors that has been an inspiration to artists like Picasso, Leger and Modigliani.

And the beadwork and blankets these women weave capture the same primitive spirit found in their paintings.

This fascinating village is just a short ride from Pretoria. And, as is the case with most South African art, you won't have to look *for* it to look *at* it. It's part of the scenery.

The work of great sculptors can be seen in public squares throughout South Africa. Ernest Ullmann's "The Playmakers" (illustrated above) stands in front of Johannesburg's Civic Theatre.

SAA 707's fly the fastest, most direct routes to this land of wonderful contrasts...via the Cape Verde Islands or Rio de Janeiro. And our 747's serve 13 major European gateways.

And South African's Blue Diamond first class or Gold Medallion economy service lets your African adventure begin the moment you step aboard one of our Stratojets.

You'll love getting there. And we'll love getting you there.

SAA

SOUTH AFRICAN AIRWAYS

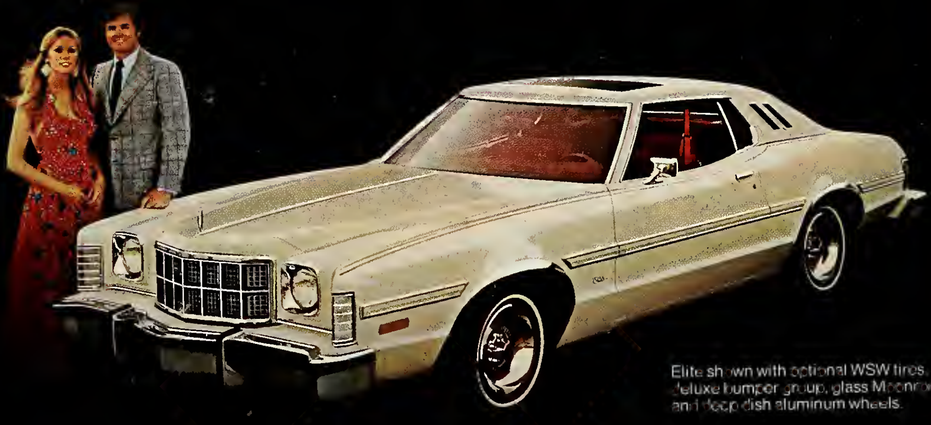
To the land of wonderful contrasts.

NEW YORK, 605 Fifth Ave./CHICAGO, Suite 2106, 67 E. Madison St./HOUSTON, Suite 1519, 1100 Milam Building/LOS ANGELES, 606 S. Olive St.
SAN FRANCISCO, 360 Post St./TORONTO, Suite 2610, P.O. Box 195, Toronto Dominion Center, Royal Trust Tower

Announcing a mid-size car in the Thunderbird Tradition.

THE 1975 FORD

Elite



Elite shown with optional WSW tires, deluxe bumper group, glass Moonroof and deep dish aluminum wheels.

Ford Elite combines the operating economy of a mid-size car with styling and luxury in the Thunderbird tradition. And in the Thunderbird tradition of value, Elite comes to you complete. Unique twin opera windows and grained vinyl roof. Driving conveniences standard, like 351 CID V-8, power steering, power front disc brakes, SelectShift transmission and steel-belted radial ply tires. Elite is available with power-operated Moonroof and other Thunderbird inspired options. And it's designed with a big 26½ gallon fuel tank which means a cruising range you can really rely on. The personal luxury mid-size Ford Elite for 1975. Built for the way you drive today.

Elite Interior Decor Group option with AM radio, automatic speed control.

THE CLOSER YOU LOOK, THE BETTER WE LOOK.

FORD ELITE

FORD DIVISION

NATURAL HISTORY

DECEMBER 1974 · $1

Now's the time to invest in signed originals by Waterford.

Each piece of Waterford crystal is a signed work of art, made by hand with heart, as it was two hundred years ago.

No other crystal has a higher lead content.

Hold Waterford to the light and you can see faintly etched the mark that identifies it as an authentic work of art.

There's no more propitious time for you to invest in Waterford.

Each piece of Waterford crystal is an investment in timeless beauty. You live with it now; yet it grows more valuable with the passing years.

Recognizing the cherished heritage that is Waterford's alone, museums the world over exhibit antique pieces of this fabled Irish crystal.

To illustrate a few current works of art:

Kinsale goblet, $11
Vase; 8" $30.50;
10" $49; 12" $63.50
Tall Salt & Pepper,
$26.50 the pair.

If you'd like to see more, visit the Waterford Gallery at the important store in your area. Or write for free full-color booklet. Waterford, 225 Fifth Avenue, New York, New York 10010.

Isn't it time you started collecting signed originals by Waterford?

(And English bone china by Aynsley, to go with it?)

photo: Pesin

NATURAL HISTORY

Incorporating Nature Magazine
Vol. LXXXIII, No. 10
December 1974

The American Museum of Natural History
Gardner D. Stout, President
Thomas D. Nicholson, Director

2 Authors

6 Captive Breeding: Boon or Boondoggle
David R. Zimmerman
The whooping crane's future remains cloudy despite benevolent human intervention.

22 The Shell Game
Syd Radinovsky and Alex Henderson
Hermit crabs in mobile homes often get eviction notices.

30 Celestial Events
Thomas D. Nicholson

32 'Twas the Eve of Saint Nicholas
Text and photographs by Rudi Haas
In an Austrian mountain village, "sugarplums" aren't the only Christmastime visions in children's heads.

38 The Taung Skull Revisited
Phillip V. Tobias
A young hominid has stirred a half century of controversy.

44 A Hominid Skull's Revealing Holes
C. K. Brain
Our early enemy stalked through the night.

46 A Special Light to Steer By
William G. Wellington
Some insects have a polarized view of life.

54 A Vision of Primal Man
A review by Peter Beard
Leni Riefenstahl's photographic tribute to the Nuba of Africa.

64 A Matter of Taste: The Taste Makers
Raymond Sokolov

68 This View of Life: Darwin's Delay
Stephen Jay Gould
What fears kept him from publishing his great discovery?

71 Additional Reading

72 Sky Reporter: Molecules between the Stars
Richard McCray

80 Announcements

Cover: *Painted to represent a skeleton, a Nuba man stands at a vantage point above his village to keep evil spirits away from the deceased before a burial. Photograph by Leni Riefenstahl. Book review on page 54.*

Alan Ternes, Editor
Thomas Page, Designer
Board of Editors:
Sally Lindsay, Frederick Hartmann,
Christopher Hallowell, Toni Gerber
Carol Breslin, Book Reviews Editor
Florence G. Edelstein, Copy Chief
Karen Bierstedt, Copy Editor
Angela Soccodato, Art Asst.
Diane Pierson, Editorial Asst.
Lillian Gindea
Rosamond Dana, Publications Editor
Editorial Advisers:
Dean Amadon, Dorothy E. Bliss,
Mark Chartrand, Niles Eldredge,
Vincent Manson, Margaret Mead,
Thomas D. Nicholson, Gerard Piel,
Richard G. Van Gelder

David D. Ryus, Publisher
L. Thomas Kelly, Business Manager
Sue Severn, Production Manager
Ernestine Weindorf, Administrative Asst.
Yung-mei Tang

Ann Brown, Circulation Manager
Joan Mahoney
Harriet Walsh

Harvey Oshinsky, Advertising Manager
Salesmen: Gordon Finley
Harry R. Jeter, Vic Asselin
Eileen O'Keefe, Production
Katrin Magnusson, Asst.

Publication Office: The American Museum of Natural History, Central Park West at 79th Street, New York, N.Y. 10024. Published monthly, October through May; bimonthly June to September. Subscriptions: $8.00 a year. In Canada and all other countries: $10.00 a year. Second-class postage paid at New York, N.Y. and at additional offices. *Copyright © 1974 by The American Museum of Natural History. No part of this periodical may be reproduced without the written consent of* Natural History. *The opinions expressed by authors do not necessarily reflect the policy of The American Museum.* Natural History *incorporating* Nature Magazine *is indexed in* Reader's Guide to Periodical Literature.

Change of address notices, undeliverable copies, orders for subscriptions, and other mail items are to be sent to
Natural History Magazine,
Membership Services, Box 6000,
Des Moines, Iowa 50306.

Authors

A strong avocational interest in ornithology stimulated **David R. Zimmerman** to investigate the government's Endangered Wildlife Research Program. As part of that program, the Bureau of Sport Fisheries attempted to save the whooping crane from extinction through captive breeding at its Patuxent facilities in Maryland. Zimmerman's investigation has, however, raised serious doubts about that effort. Currently the president of the Society of Magazine Writers, Zimmerman teaches a course on article writing at the City College of New York, and conducts a monthly column, "Medicine Today," in the *Ladies' Home Journal.* His article in this issue of *Natural History* is based on a chapter from a book he has written on the management of endangered birds, scheduled for spring publication by Coward, McCann & Geoghegan, Inc.

Syd Radinovsky has been studying terrestrial hermit crabs for almost ten years. Numerous trips to the Florida Keys, haunt of the purple-clawed hermit crab, have enabled him to observe these crustaceans in the wild and learn how they appropriate the empty gastropod shells they need for living on land. A professor of zoology and entomology at Millersville State College in Pennsylvania, Radinovsky has also studied the biology and behavior of mites. He plans to continue his work with land crabs, examining their mating behavior, incubation period, and egg hatch in the field and in the laboratory.

Alex Henderson, coauthor of "The Shell Game," has concentrated his research on larval development of the purple-clawed hermit crab. He was a member of the team that studied these crustaceans on Boot Key, off the coast of Florida. A professor of biology at Millersville State College, Henderson is now investigating territoriality in the box turtle.

Statement of ownership, management, and circulation (Act of August 12, 1970, Section 3685, United States Code) of Natural History, published ten times a year at The American Museum of Natural History, Central Park West at 79th Street, New York, N.Y. 10024, for October 1, 1974. General business offices of the publisher are located at Central Park West at 79th Street, New York, N.Y. 10024. Publisher, David D. Ryus; editor, Alan P. Ternes, Central Park West at 79th Street, New York, N.Y. 10024. Owner is The American Museum of Natural History, Central Park West at 79th Street, New York, N.Y. 10024. Known bondholders, mortgagees, and other security holders owning or holding one percent or more of total amount of bonds, mortgages, or other securities: None. The purpose, function, and nonprofit status of this organization and the exempt status for federal income tax purposes have not changed during preceding 12 months (Section 132.122, Postal Manual). The average number of copies of each issue during the preceding 12 months are: *A.* Total number of copies printed: 349,935; *B.* Paid circulation: *1.* Sales through dealers and carriers, street vendors, and counter sales: 1,178; *2.* Mail subscriptions: 339,807; *C.* Total paid circulation: 340,985; *D.* Free distribution by mail, carrier, or other means: 4,493; *E.* Total distribution: 345,478; *F.* Office use, leftover, unaccounted, spoiled after printing: 4,457; *G.* Total: 349,935. The actual number of copies of single issue published nearest to filing date are: *A.* Total number of copies printed: 348,187; *B.* Paid circulation: *1.* Sales through dealers and carriers, street vendors and counter sales: 775; *2.* Mail subscriptions: 340,727; *C.* Total paid circulation: 341,502; *D.* Free distribution by mail, carrier, or other means: 4,401; *E.* Total distribution: 345,903; *F.* Office use, leftover, unaccounted, spoiled after printing: 2,284; *G.* Total: 348,187. I certify that the statements made by me above are correct and complete.

L. T. Kelly, Business Manager

Austrian-born **Rudi Haas** spent part of his childhood with his grandparents in the small alpine village of Bad Mitterndorf, where each December he observed the procession of strangely garbed figures on the eve of Saint Nicholas Day. Haas, a professional photographer, recently returned to the village to probe the origins of the legendary characters personified during that annual event. He discovered that although the figures were once familiar in many parts of Europe and Asia, they can now be seen only in Bad Mitterndorf. A resident of Canada since 1958, Haas has photographed North American Indian societies for several museums.

SPRINGS
OF ALL
KINDS

HOLIDAY SHOPPING is never too hurried in Moore County, Tennessee. Generally, our citizens get a lot of it done with a visit to the Lynchburg Hardware and General Store. We hope your holiday preparations are equally free of haste. And that you find goodly time to savor the season with your family and close friends.

CHARCOAL
MELLOWED
DROP
BY DROP

Tennessee Whiskey • 90 Proof • Distilled and Bottled by Jack Daniel Distillery
Lem Motlow, Prop., Inc., Lynchburg (Pop. 361), Tennessee
The first Distillery placed in the National Register of Historic Places by the United States Government.

4/5 QUART
JACK DANIEL'S
Old No. 7
Tennessee
WHISKEY

For people who are still individuals...

the Irish country hat

Each Irish country hat is handcrafted with pride by skilled artisans on the wild, western coast of Ireland. These hats are created by individuals, not production lines, and are designed to become an extension of your own personality.

Shape your Irish hat to suit yourself

The style of your hat can say a lot. That's why the Irish hat leaves the final shape up to you.

Benedicte Boullet, Paris, France

The hand-woven tweed is extra thick, and fully lined in the crown. It sheds rain, protects from the wind, and can give you a comfortable shade from the sun.

Peter Christian, London, England

Irish country hats are made exclusively for Norm Thompson, and come in distinctive gray or brown tweed mixes. Sizes 6½ to 7⅝. Each $15.00. Two for $29.00.

You have full return privileges.

Norm Thompson
Dept. NH-D
1805 N.W. Thurman
Portland, Ore. 97209

Order toll free any time: (800) 547-6712
(Excluding Oregon, Hawaii & Alaska)

Irish Hat(s)	Qty.	Size	Brown	Gray
Men's: 6½-7⅝				
Women's: 20¼-25				

☐ Check enclosed. ☐ Charge to my BankAmericard. ☐ Master Charge. (Include all raised letters and numbers on card.)

Card No.

Signature X

☐ Send free 80 page color catalog, *"Escape from the ordinary"*

Name

Address

City State Zip

Paleoanthropologist **Phillip V. Tobias** holds the same position in the Department of Anatomy at the University of the Witwatersrand in South Africa that anthropologist Raymond A. Dart held fifty years ago when he discovered the controversial Taung skull, the subject of Tobias's article. Tobias attributes part of his interest in paleoanthropology to his long working relationship with the late Louis Leakey, famous for his discoveries of hominid fossils in East Africa. Tobias also worked closely with Robert Broom, who—along with Dart and Leakey—is considered one of the "wild men" of African hominid fossil studies.

C.K. Brain is the director of the Transvaal Museum in Pretoria, South Africa. In addition to his work at the Swartkrans cave site, Brain has been associated with the excavation of four other well-known South African hominid sites: Sterkfontein, Taung, Makapansgat, and Kromdraai. He has also studied the diet of, and the affect of climatic change on, early man in Rhodesia and looked into patterns of fossil bone weathering.

Spending the summer noon hour in his garden is not a form of relaxation for **William G. Wellington.** Instead, he uses that time—when polarized light waves are at a minimum—to investigate how insects employ such rays for navigation. Wellington is director of the Institute of Animal Resource Ecology and professor of plant science and resource ecology at the University of British Columbia in Canada. He is the author of "Tents and Tactics of Caterpillars," which appeared in the January, 1974, issue of *Natural History.*

You can help save Julyi Latemoon for $15 a month.
Or you can turn the page.

Julyi Latemoon.
Descendant of a proud people.
Her ancestors understood
man's harmony with nature.
They were master craftsmen, farmers, and hunters.
Now they are a forgotten people
to whom many promises have been made.
And few kept.
Julyi is poor but has an abundance of hope.
She needs a helping hand.
And a friend who will understand.

For $15 a month, through Save the Children Federation, you can sponsor a child like Julyi so that she will not be forgotten. Give her an education so she can grow up to walk among her people with dignity and respect. And a portion of your $15, combined with money from other sponsors, will also help her family and the people of her community. With a desperately needed food co-op, income-producing handicraft programs, vocational training, youth activities, clinics, and more. In simple terms, help a proud people help themselves. For this is what Save the Children has been all about since 1932.

For you—educated, involved, and in touch with your own heart—there are many rewards. Correspond with a child. Receive a photo and progress reports. Reach out to another human being. That's how Save the Children works. But without you it can't work. So please: clip this coupon and mail it today. Now you can turn the page.

Save the Children Federation is indeed proud of the handling of its funds. An annual report and audit statement are available upon request. Registered with the U.S. State Department Advisory Committee on Voluntary Foreign Aid. Contributions are income tax deductible.

I wish to contribute $15 a month to sponsor a ☐ boy ☐ girl:

☐ **Where the need is most urgent**
☐ Appalachia (U.S.)
☐ Bangladesh
☐ Chicano (U.S.)
☐ Colombia
☐ Dominican Republic
☐ Greece
☐ Honduras
☐ Indian (U.S.)
☐ Inner Cities (U.S.)
☐ Israel
☐ Korea
☐ Lebanon
☐ Mexico
☐ Southern Black (U.S.)
☐ Tanzania
☐ Vietnam

Enclosed is my first payment:
☐ $180 annually
☐ $90 semi-annually
☐ $45 quarterly
☐ $15 monthly

☐ Instead, enclosed is my contribution of $__________
☐ Please send me more information.

NAME____________________ TEL. NO.__________

ADDRESS____________________________

CITY____________ STATE__________ ZIP______

David L. Guyer, Executive Director
SAVE THE CHILDREN FEDERATION
345 East 46th Street, New York, N.Y. 10017
NH 12/4

Captive Breeding: Boon or Boondoggle*

With underfinanced friends like the Endangered Wildlife Research Program, the whooping crane doesn't need enemies

Each year more animals are added to lists that foreshadow their imminent demise. With each addition, the need for action to save threatened species from extinction grows greater.

In one proposed method, captive breeding, a few individuals are taken from the wild and placed in a breeding facility. After a few years, their hopefully plentiful progeny—untamed traits carefully nurtured and intact—are then set free to bolster the dwindling wild population.

In the 1960s, the federal government took its first definitive steps on behalf of America's best-known endangered bird, the whooping crane (*Grus americana*). The United States Fish and Wildlife Service assigned the project to the newly created Endangered Wildlife Research Program at its Patuxent facility in Maryland.

The original plan was to take eggs from the whooping cranes' nesting grounds in Canada in alternate years; hatch them; raise them to breeding age; mate them, either naturally or by artificial insemination; build up a flock of twenty breeding pairs; and then find ways to return their offspring or their offspring's offspring to migratory niches in nature.

A key factor in whooping crane breeding behavior allowed hope for considerable enhancement of the birds' numbers through captive breeding, without great risk to the wild population. A pair of wild cranes produce a single clutch, usually of two eggs, each year. Most eggs hatch, but between hatching, in late spring, and the day in autumn when the whoopers return to their wintering grounds at Aransas Bay on the south coast of Texas, there is an enormous—and still poorly explained—loss of young. Typically, fewer than half of the hatchlings survive to autumn.

By contrast, captive whooping cranes and cranes of other species have been induced to lay half a dozen or more eggs in a year. If propagation of a captive pair were to yield even four young in a year—and Patuxent authorities consider this possible—then that pair would be 300 percent more productive than a pair of birds in the wild. While they have by no means achieved it, Patuxent officials also feel that by sheltering captive breeding birds from the rigors of the wild they can perhaps double the whooping cranes' productive years.

Work began in earnest in the spring of 1967. Eggs were taken from whooping crane nests at Wood Buffalo National Park, in the swampy, remote southern fringe of Canada's Northwest Territories, and flown to Patuxent, where they hatched. Eggs were also taken in subsequent springs, and twenty-one of the huge white birds are now

---

*Boondoggle: "An impracticable or useless project wasteful of time and money."
Webster's Third New International Dictionary

by David R. Zimmerman

being kept in pens at Patuxent.

This project is favored at Patuxent because whooping cranes are the bellwether species around which the endangered wildlife program was formed. The program's first—and only—director, Ray C. Erickson, began his study of whooping cranes in 1956, and he urged that a captive breeding venture be undertaken.

Patuxent thus is an important chapter in an old conservation story and the opening chapter of a new one. As one of the first attempts to propagate a wild bird and reintroduce it into a migratory niche in nature, the crane work is a scientific challenge as well as a test of the government's commitment.

DAVID BLANKINSHIP; NATIONAL AUDUBON SOCIETY

The project has had some successes, but there have also been setbacks and failures. Regrettably, problems have mounted to a point where they provoke persistent criticism from crane specialists and conservationists—both inside and outside of government—in the United States and in Canada. While some say Erickson and his colleagues are doing the best they can, given the limits under which they must work, others say progress has been too slow to justify continuing the project unless changes are made.

Among the major complaints are the lack of progress toward the key goal of inducing captive whooping cranes to breed and some avoidable errors that have led to the injury and death of several of the precious young captives. Critics of the program almost universally feel that a credibility gap has developed between the meager, highly managed, and largely self-justifying information released about the project by Erickson and others and a far less felicitous reality, which is rarely discussed candidly with outside scientists or the press.

Cranes are delicate birds, difficult to work with. No one has ever raised large numbers of whooping cranes under wire. Nor, despite many attempts, has anyone induced captive whooping cranes to breed productively. Patuxent's harshest critics are forced to agree that bench marks are hard to specify.

Part of the problem, however, is unrelated to the birds. Because the sole official source of detailed information is Erickson, who carefully manages most, if not all the news that is released, no one outside the Patuxent facility knows enough to make a fully informed judgment.

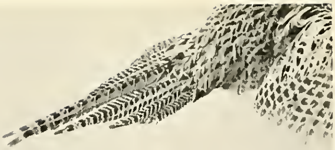
Historically, the central conflict in crane conservation has been that of protection versus propagation. The protectionists, led by the National Audubon Society, have long held that whooping crane refuges and flyways must be made more secure, but that the work of increasing the population must be left to the birds themselves. Protectionists object to captive propagation, arguing that the chances of successfully returning birds to nature are too poor to justify taking eggs.

Whooping crane conservation had already been rewardingly successful. Creation of a federal wildlife refuge at the Aransas wintering grounds, education of hunters along migratory flyways, and other conventional efforts raised the total number of wild, migratory whooping cranes from a low of fourteen in 1938 to more than four times that number, fifty-nine, in 1971, only thirty-three years later. (A severe setback reduced the wild population to forty-five birds in 1973.)

Propagationists argue that the cranes are too close to extinction not to try captive breeding to increase their numbers, particularly as a hedge against a natural or man-made disaster that could kill many or all of the wild population in a single blow.

Erickson steers a middle course. He takes enough eggs to satisfy all but the most die-hard propagationists, and he prevails against protectionist critics by arguing that he does not take enough eggs to jeopardize the wild population.

Originally, he advocated alternate-year egg taking to let the wild birds recoup any losses. Now, he asserts that a surprising discovery allows for a far more aggressive egg-taking schedule. Confounding everyone's expectations, Erickson reports that the first three years of



Because they're birds and they're free! So you have to change your photo habits. One ingenious solution is a zoom lens. It gives you a fast change of focal lengths without moving the camera from your eye.

The Vivitar Automatic Zoom lens goes from 85 to 205mm, opens up to an impressive f3.8 and isn't any larger than most standard 200mm lenses. The highly sophisticated optical design has 13 elements in 9 groups. The Vivitar Automatic Zoom is designed to fit most 35mm SLR cameras.

See a demo at your photo dealer or write for test reports by leading photo magazines.

Why don't birds stay where they are while you change lenses?

Vivitar Zoom Lenses

Marketed in the U.S.A. by
Ponder&Best, Inc.,
1630 Stewart Street,
Santa Monica, California 90406.
In Canada: Precision
Cameras of Canada, Ltd., Que.

The 13th green on the South Course of John's Island—approached by a 207-yard carry over water.

Two championship golf courses are an important part—but only a part—of the superb sports facilities on John's Island. Designed, built and maintained for a discriminating, conservative clientele, this privately owned resort community offers residential properties, golf cottages and oceanfront apartments for both purchase and rental. For our handsome hard-cover book, illustrated with 99 color photographs and available at $5, write to Roy D. Chapin III, 214 John's Island Drive, Vero Beach, Florida 32960.

john's island

Obtain the HUD Property Report from developer and read it before signing anything. HUD neither approves the merits of the offering nor the value of the property as an investment, if any. This offering is not available to residents of states where prohibited by law. AD# 12088

egg taking were associated, not with a decrease, but with an increase in the number of fledged wild young whoopers that reached Aransas each autumn. Egg taking did not reduce productivity in the wild; it might even have been of help.

If what Erickson says is true, criticism of egg taking has, in effect, been trumped since, like the farmer's thinning of his row, it can be justified as improving the yield.

The wild flock increased by approximately four birds per year in the first three years of egg taking, compared to an increase of about one bird per year in other years.

Researchers had observed that when no eggs are removed, a mated pair rarely returns to Aransas with more than one rusty brown young-of-the-year in tow. Erickson's hypothesis is that newborn whooping cranes are so hostile and aggressive toward each other that when there are two, one often kills the other. If this is so, then taking one egg would not decrease productivity.

After the first egg taking in 1967, eggs were taken in 1968, 1969, and 1971. None were taken in 1970, 1972, or 1973. This year, thirteen eggs were taken, for a total of fifty in eight years.

Researchers had expressed fear that moving the eggs thousands of miles would kill the developing embryos. It has not. The technique developed by National Audubon Society biologist C. Eugene Knoder (then with the Fish and Wildlife Service) to transport the eggs—which are flown by helicopter and Canadian armed forces jet planes in a lap-borne, padded, heated suitcase—has been glowingly successful. Erickson claims the hatch rate for viable eggs is about 90 percent, like that of whooper eggs left undisturbed in the wild.

Subsequent to hatching, however, the sailing has not been so smooth. Of the forty eggs hatched at Patuxent, nineteen birds remain alive (the Patuxent flock of twenty-one includes two birds born elsewhere).

Six eggs were taken in 1967, the first year of the program. One bird pipped its shell on the plane and died for want of oxygen in the struggle of birth; since then bottled oxygen has been carried aboard the planes. Shortly after hatching, the biggest and healthiest member of the class of '67 died mysteriously

The all-aluminum, no-deposit, no-waste can.

ALL ALUMINUM

Reynolds pays you to return it.

We don't believe in waste.

Waste of America's aluminum resources. Waste of energy. Waste of any kind. That's why Reynolds is vitally interested in recycling aluminum products. Our far-reaching programs to recycle aluminum beverage cans, starting in 1967, show the extent of our commitment.

Last year, Reynolds paid Americans about 4.5 million dollars for bringing in used aluminum beverage cans. That was based on 10¢ per pound. Today, we're paying 15¢ per pound for aluminum scrap brought to our recycling centers.

Unlike container taxes or deposits, our program put 4.5 million dollars in *new* money into American pockets and purses.

And helped conserve one of America's most valuable resources — energy. That's because recycling takes only 5% of the energy needed to create aluminum from virgin ore.

We're recycling other forms of aluminum, too. From used Reynolds Wrap® to old utensils, lawn furniture, scrap from industry, etc. Into new aluminum products that cut fuel-energy consumption in automobiles and other transportation equipment. Into building products that save heating and cooling energy.

And Reynolds means to do even more. We have programs under way to recover aluminum from solid waste...to literally mine the garbage heaps of the nation.

Today's waste *can* be tomorrow's resources. *Reynolds Metals Company, P.O. Box LII, Richmond, Virginia 23261.*

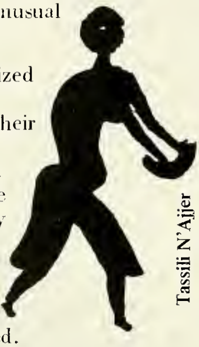
REYNOLDS
where new ideas take shape in
ALUMINUM

Conserving our resources and energy.

NEW HORIZONS FOR THE SEASONED TRAVELLER

For the adventurer, Office of Academic Liaison has selective tours to very unusual destinations.

On our specialized tours led by authorities in their field you will participate in a new way of life and come away satisfied with a true understanding of the people you have visited.



Escape with us to a new and different world.

North and South of the Niger

Extensive travel in the Niger Bend in Mali. Traditional art of the Dogon, Malinke, and Bambara.

Yemen

Fertile mountain land of Arabia. Traditional kingdom of the Queen of Sheba long inaccessible to the West. Unusual architecture six to ten storey buildings from another millennium.

Central Sahara

Journey through the moonscape setting of the Hoggar Mountains. Domain of the matriarchal Tuareg people. Rock and cave paintings in Tassili N'Ajjer witness neolithic civilizations of the once green Sahara.

Maldives

Enchanted Isles of the Indian Ocean. Island safaris to outlying atolls.

Our program of summer tours is also available.

Please forward complete information regarding
☐ Mali ☐ Central Sahara
☐ Yemen ☐ Maldives
Name__________
Address__________
City__________
State__________
Zip Code__________

Office of Academic Liaison
640 Cathcart, Suite 307
Section NHD, Montreal
Canada H3B 1M3

during a severe electrical storm.

Two others of that first class developed crippling bone dislocations at the knee joint. Both died. Erickson says the problem appears to have been caused by an imbalance of calcium in the birds' diet, which interfered with maturational hardening of their bones. Seven years later, only two of the six members of the class of '67 remain alive.

The class of '68 started with ten whoopers; six are still living. One died in an electrical storm, and three others died of an amoebalike infection, which Erickson attributes to their being put out in the hot Maryland sun at six weeks of age—when they were too young to stand the heat. Young birds now are kept indoors for three months, but this has not wholly solved the temperature-control problem. As of 1973, none of the buildings available for young whooping cranes had air conditioning. In 1969, ten eggs were brought back. Three failed to hatch; two were later shown to have been infertile.

Newborn whooping cranes must be taught to eat. Patuxent workers decided to present food to the young birds on a simulated beak tip—a wooden tongue depressor. Most captive whooper hatchlings learn to eat in this way. One in the class of '69 failed to—and died. Another became paralyzed, was unable to stand, and died three weeks later. Why this happened is a matter of some contention. Erickson says the "paralysis was perhaps due to pen-induced injuries."

So-called hardware disease claimed one classmate. It grew ill, failed to respond to therapy, and died. At autopsy, the bird was found to have swallowed a nail, which perforated its intestinal tract. This might have been discovered by X-ray, resulting in life-saving surgery, but at that time Patuxent did not have an X-ray apparatus. At present four from 1969 remain alive and well.

No eggs were taken in 1970. The class of '71 already is the least successful. Only three of its members survive. Of eleven eggs taken, two failed to hatch and two hatchlings, defective and weak, soon died. "One," says Erickson, "had to be helped from its shell because its head was positioned between its legs—a poultryman would just have thrown it out." It died within a

THE EIGHT DEADLY SINS GLASSES: But there are only seven deadly sins, you say. Not any more. In these days of winning and losing, success and failure, some realist has come up with the eighth deadly sin. We won't keep you in suspense any longer. It's: Choosing The Wrong Side. Don't you know someone who'll dig the whole premise? A Collection exclusive. 12.50 the set of eight stackable 10-ouncé glasses. #3386A. 12.50 (2.75 postage and handling).

FROM THE HORCHOW COLLECTION
P. O. Box 34257 Dept. 01686
Dallas, Texas 75234
☐ Please send_____sets of the eight deadly sins glasses. Check enclosed.
☐ Please add me to your catalogue mailing list.

Tiffen can help you learn about the birds and the bees.

Tiffen makes compact high quality Hi-Trans® binoculars designed with the outdoorsman in mind. And our unique Roof Prism Optical System is of such fine quality and durability, you'll find them only where fine cameras are sold. And at a price much less than you'd expect.

Ask to see all five models of Tiffen Hi-Trans® binoculars. And from then on, no matter which pair you choose, you can get as close to nature as you want. Write for literature.

Tiffen. The binoculars with camera quality lenses.

TIFFEN
Manufacturing Corp.
75 Jane Street
Roslyn Heights, N.Y. 11577

week. The other would not eat and had to be force-fed. It had been born with a circulatory disorder and died of food impacted in its esophagus.

Four others died, early on, of what turned out to be pneumonia-like bacterial infections. Because of the circumstances of their deaths, Erickson was especially grieved. Standard avicultural practice calls for segregating newborn birds from older ones, which have already developed immunologic defenses and can tolerate the disease organisms that they carry and shed from their bodies. Young birds, lacking such defenses, fall easy prey to these germs, which is what happened when, for want of space, the 1971 whoopers were penned up near a group of older sandhill cranes. This unfortunate loss of chicks, Erickson says, thus was due to difficulties that were both "detectable and correctable."

But this year's results also have been poor. Of thirteen eggs picked up, two lacked embryos. Nine hatched, but many seemed poorly developed and weak. Five died, most of them from bacterial infections that entered their umbilical areas, which had not closed properly. Four birds survive.

Therefore, from a total of fifty eggs that produced forty young, nineteen cranes ranging from one to seven years of age remain alive at Patuxent. Most of them had been kept together as a flock in a small (four-acre) fence-enclosed run.

The aim is not just to keep the cranes alive—a feat zoo keepers long ago achieved—but to get them to breed. In the past, zoo keepers have had mated pairs that produced eggs, some of which were fertile. But few hatched and even fewer survived to maturity. So the task of perfecting reliable propagation methods rests with Patuxent.

The Patuxent workers believe they can best capitalize on the great experience and expertise of poultry scientists by treating the whoopers like exotic "chickens." Indeed the very choice of Patuxent as the site for the crane-breeding project is due in part to its immediate proximity to the U.S. Department of Agriculture poultry research facility at Beltsville, Maryland, which developed the tender Thanksgiving turkeys of that name.

For example, the newborn

Shopping for Surprises

with *Harry and David*
Creators of the Fruit-of-the-Month Club®

BONSAI JUNIPER
Nature in miniature — this little tree is already three years old, yet just 6 inches high. Planted in a special clay pot; comes with 96-page handbook on the ancient and subtle art of Bonsai. Available all year.
Order Gift No. 261 . . . $12⁹⁵ delv'd

our famous
ROYAL RIVIERA® PEARS
So big and juicy they'll eat 'em with a spoon — so rare, not 1 person in 1000 has ever tasted them! Beautifully gift packed and sent with your personal greetings. Perfect arrival guaranteed! Net wt. 6-3/4 lbs. Order now for Thanksgiving and Christmas delivery.
Order Gift No. 1 . . . . . $7⁹⁵ delv'd

CHRISTMAS CROCUS
Completely pre-planted and ready to grow in a genuine handpainted Delft planter! Nothing to add but water — includes 12 top size bulbs. Do order NOW for Christmas delivery! Available Dec. 10 to Feb. 14.
Order Gift No. 801 . . . . $9⁹⁵ delv'd

The Original, One-and-Only
Fruit-of-the-Month Club®

Since 1936, America's favorite family club. Month after month, a parade of the world's rarest and finest fruit sent direct from the orchard. Each gift box with your greetings. All announced by a handsome, gold-embossed Certificate of Membership.

Christmas — Royal Riviera Pears	April — Hawaiian Pineapples	August — Exotic Nectarines
Jan — Crisp Mountain Apples	May — Wild 'n Rare® Preserves	Sept — Oregold® Peaches
Feb — Royal Grapefruit	June — Home-Canned Fruits	Oct — Alphonse LaValle Grapes
March — Royal Oranges	July — Giant Kiwi Berries	Nov — Spanish Melons

3-BOX CLUB Surprise them with gorgeous gift boxes for Christmas, January and February!
Gift No. 111 . . . $21⁹⁵ delv'd

5-BOX CLUB Keeps coming and coming! Christmas, January, February, May and September.
Gift No. 141 . . . $34⁹⁵ delv'd

8-BOX CLUB Delight them to pieces again and again! Christmas, January, February, May, August, September, October and November.
Gift No. 151 . . . $59⁹⁵ delv'd

12-BOX CLUB Flabbergasting! A gorgeous gift every single month of the year.
Gift No. 201 . . . $86⁹⁵ delv'd

We guarantee your complete satisfaction in every respect . . . or your money back!

Every year folks write to tell us how pleased their friends are with gifts from Harry and David. Our "secret"? It's the personal touch that's part of every gift we make. Harry and I grow our own fruit, bake our own cakes, put up our own preserves — even make our own baskets. If you could see the care with which our gifts are put together, you'd know why the quality is guaranteed.

EASY TO ORDER Use the order blanks at right, or just send us your list. Enclose check or money order (no C.O.D.'s please). Tell us how to sign your greetings for each gift. All prices include delivery.

Send your orders to:

Harry and David®
Box 553-B Medford, Oregon 97501

© 1974, Harry and David

Order here or send us your list

SHIP AS MY GIFT TO ______
STREET ______
CITY ______ STATE ______ ZIP ______

Quantity	Name of Gift	Order No	Amount
			$

Ship to Arrive for Christmas ☐ Ship to Arrive On (Date) ______ Use Card I enclose ☐ (Max 3½ x 5)
Greetings to read: ______

SHIP AS MY GIFT TO ______
STREET ______
CITY ______ STATE ______ ZIP ______

Quantity	Name of Gift	Order No	Amount
			$

Ship to Arrive for Christmas ☐ Ship to Arrive On (Date) ______ Use Card I enclose ☐ (Max 3½ x 5)
Greetings to read: ______

Ordered By ______
Address ______
City ______ State ______ Zip ______

553-B

Cloud-Soft Travelers

Goose Down Sox for Men and Women

Slip on a pair of these to keep your feet warm in sleeping bag or bed; as inner sox for insulated pacs or waders. Downright comfortable travel slippers. Bauer Goose Down quilted in tough, washable Nylon taffeta. **Colors:** Red, Winter Blue, Taupe, Powder Blue. Specify shoe size and we will send a proper fit. **0123** Goose Down Sox, pair **$8.95** postpaid.

Order Today! Money Back Guarantee!

Enclosed is my check or money order for $______. (Add sales tax where applicable.) Please RUSH my 0123 Goose Down Sox.

Men's Size______Color______

Women's Size______Color______

Name______

Address______

City______

State______Zip______

☐ Send me FREE your new color catalog of over 1200 exciting outdoor products.

Eddie Bauer®

Dept. QNH, 1737 Airport Way S., Seattle, Wa. 98134

VENOMOUS ANIMALS OF THE WORLD

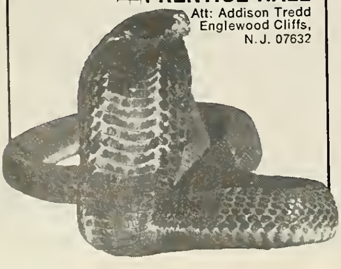
BY ROGER CARAS

This giant volume identifies and explains (even listing antivenins!) how virtually *all* of the world's tooth-and-tail venemous killers hunt, defend themselves and threaten man. With hundreds of rich illustrations, this long-awaited, authoritative work at last replaces nonsensical folklore with fact. Foreword by Dr. Sherman Minton, School of Medicine, Indiana University. Illustrated with 150 halftones, 16 in color, and 23 line drawings. $25.00

At your bookstore or direct from:

PRENTICE-HALL

Att: Addison Tredd
Englewood Cliffs,
N.J. 07632



whoopers were raised in a flock because poultrymen have observed that, in the absence of parents, young birds are more apt to thrive and are easier to maintain when they are together than when they are apart. Erickson says there is also some evidence from sandhill cranes that firm pair bonds and successful matings are more likely if the birds can pick their own mates from a flock, rather than have a mate imposed by their keepers. Whether or not such free choice is preferable for whooping cranes—which by nature are far more solitary than sandhills—remains the subject of considerable, unresolved controversy.

Recently, eight birds have been segregated as four pairs, each pair in a separate pen. The rest of the flock, including hatchlings from the 1974 egg pick-up, have not paired off.

The extreme pugnacity of baby whooping cranes, almost from the moment of birth, threatened the group-living arrangement. To protect them, Patuxent adopted another stratagem of poultrymen, adding young birds of a different, noncombative species to the pen as a buffer. Seeing the young whooping cranes chase and brutally peck one another, Erickson penned in with them some downy turkey chicks and also some newly hatched sandhill crane chicks. The whooper chicks obligingly turned their intense aggressiveness against the turkeys. The turkeys ran faster than the cranes, however, and usually escaped, defusing the cranes' aggressions and drawing them away from their own kind.

The Patuxent group has eschewed the suggestion that whooping cranes be kept from imprinting on humans, and that they be denied other human encounters that might make them less wary, thereby compromising their wildness. Erickson maintains that he lacks the money to build—and the manpower to run—the kind of facility in which the birds could be raised out of sight of man.

To mate mature birds by artificial insemination, they must, of necessity, be accustomed to human presence and handling. Moreover, it is not the present generation, but the next one or the one after that will be returned to the wild—and it is with that generation that Erick-

NATURE EXPEDITIONS INTERNATIONAL

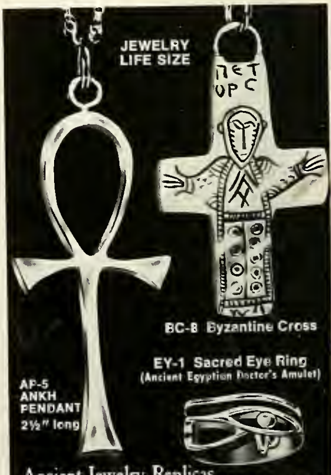
Unforgettable journeys to earth's unique habitats combining vacations with education..................

EXPEDITIONS
FOR WINTER OF 1975

BAJA CALIFORNIA PACIFIC LAGOONS
AND OFFSHORE ISLANDS
DECEMBER 26, 1974 JANUARY 2, 1975
●
GALAPAGOS ISLANDS
JANUARY 4 18
●
SIERRA NEVADA · WINTER BIOLOGY
FEBRUARY 9 15
●
HAWAII
MARCH 22-30
●
SEA OF CORTEZ
APRIL 12-19

Vacations with Education in Anthropology, Natural History and Nature Photography for the Nonspecialist to Unique Environments of the World

NATURE EXPEDITIONS INTERNATIONAL
P.O. Box 1173, Los Altos, CA 94022
Phone: (415) 941-2910



Ancient Jewelry Replicas
In 14 Karat Gold & Sterling Silver

		Sterling Silver	14K. Gold
AP-5	Ankh Pendant 24" ch.	$32.50	$119.50
BC-8	Byzantine Cr. 24" ch.	35.00	125.00
EY-1	Sacred Eye Ring	29.50	119.50

Rings sized to 11½ no extra cost. • Money back guarantee. Add $1.50 for insured postage. • Orders shipped promptly. • Bankamericard & M.C. for orders $50. minimum.

COLLECTOR'S CATALOG . . . picturing relics from ancient worlds—BC to AD. Plus special Jewelry Catalog showing ancient replicas in precious metals. Both catalogs—50¢ . . . Free With Order!

VISIT GALLERY—APPT. ONLY—CALL CI 6 0793

aladdin house, ltd.

Dept. NJ1274 • 648 Ninth Ave. • N.Y. 10036

SOLID 24K. GOLD JEWELRY AVAILABLE—PRICE ON REQUEST

son plans to face the wildness problem.

In 1971, for the first time, two three-year-old Patuxent birds presented themselves to each other in nuptial displays and attempted, unsuccessfully, to copulate. Erickson says he was not surprised by their failure; he calls it "puppy love." Nevertheless, an attempt was made to capitalize on it by artificially inseminating the apparent female with sperm from an older male. There was no "take."

Current policy is to leave the whooping cranes together in a flock, and if any two individuals form a pair bond, they are then removed to a separate breeding enclosure. Rather than wait for them to copulate, when the female appears heavy with eggs she will be artificially inseminated with semen from her mate. Once she lays, her eggs will be taken to stimulate her to lay again. The eggs will then be incubated mechanically.

Staff physiologist George Gee says that before artificial insemination is attempted, the adult pair must be put into close confinement near humans and handled each day for a week or so. The aim is to reduce shock and panic-induced self-injury that can occur if wholly untamed birds are subjected to handling and genital manipulation. An adult whooping crane weighs sixteen pounds, stands five feet high, and has a wingspan of more than seven feet. When furious, with wings, legs, body, and beak in motion, it can do considerable damage to itself and others. Gee has been highly successful at artificially inseminating sandhill cranes. He has also tried it several times with whoopers, but without success.

If, in the years to come, Patuxent succeeds in inducing captive whooping cranes to lay fertile, hatchable eggs—either naturally or through artificial insemination—only the first, and perhaps simpler, half of the task will have been completed. The still uncharted task is finding a way to return captive stock to the wild. There is little precedent for carrying a large, complex bird of such limited numbers as the whooping crane through one or more captive generations to successful reintroduction into a migratory niche in nature.

Ideas are in flux about how and

FLY THE AFRICAN EXPRESS.

It's New York to Dakar non-stop.
It's the greatest way to the last great continent.
It's Air Afrique. The African airline that knows Africa best.

Air Afrique's African Express jet adventures-off from Kennedy every Saturday at 6 P.M. Its destination: Dakar, and then on to Robertsfield/Monrovia, Abidjan, Lome, Douala, Libreville, and Kinshasa.

But Africa begins in the sky on Air Afrique. Our food is the finest African cuisine. Our stewardesses are dressed in magnificent native fabrics (one of Africa's finest arts). And our friendship is just a hint of what you'll find when you land.

Discover Africa. Our coupon can bring you closer. Our African Express can bring you there.

AIR AFRIQUE

Air France, General Agent. Box DC8
New York, N.Y. 10011
Please send me information about
Air Afrique's Africa immediately.

Name__________
Address__________
City__________ State__________
Zip__________ Phone__________
Travel agent__________
Or call any Air France office. RK-NH-12-74

Air Afrique's fleet now features DC-10's clean-powered by General Electric jet engines.

QUESTAR *PROVES* IT'S PILEATED!

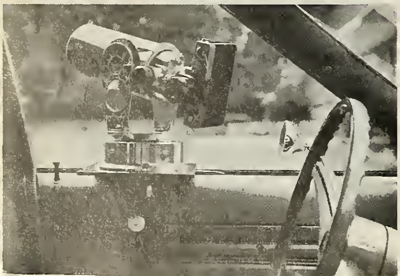
Usually it is no easy matter to distinguish the features of a bird 75 feet away, which was the distance between this pileated woodpecker and Questar. But the Questar photograph leaves no doubt as to identity, as it sharply delineates the head crest, the dark and light striping and the characteristic pose.

Questar not only brings distant wildlife to your eye and your camera, but does so while you relax inside your car, if you wish. The Carpod is one of the well-designed Questar accessories that help make it possible. It provides a firm platform for your Questar while your concealment keeps the bird unaware.

Send $1 for the Questar booklet with its 150 photographs by Questar owners. $1 for mailing on this continent; by air to S. America, $2.50; Europe and N. Africa, $3; other areas, $3.50.

QUESTAR
BOX W60, NEW HOPE, PA. 18938

© Copyright Questar Corporation 1974



where this should be done. The wild whooping crane population quadrupled—from fourteen to fifty-six—in the thirty-one years between 1938 and 1969. If the present setback proves temporary and if the population continues to double each sixteen years, by the end of the century it will surpass the Aransas refuge's estimated carrying capacity. The aim today, therefore, is less to bolster the migrators from Aransas to Wood Buffalo Park, than it is to establish a second migratory population between two new north–south terminals within the whoopers' wide former range. Besides providing added numbers of birds, it would be insurance against catastrophic storms, illness, and other disasters.

In formulating release plans, an important decision is which captive generation should be set free. "The more generations you hold birds in captivity," Knoder points out, "the more likely you are to have domestic birds instead of wild ones." In terms of time, given the late age at which whoopers breed, a two-generation-plus cycle in captivity means that ten to twelve years would pass between egg taking and the release of the third generation back to the wild.

For these reasons, and because the wild flock seems to tolerate egg taking, current plans are to release the second generation of captives—the young produced by today's captive generation. Erickson says that he will wait until he has enough breeders among his captives to insure that their eggs carry a varied representation of the genes that remain in the whooping cranes' limited gene pool. The first release, he insists, will not be before 1980.

The key questions of when—that is, at what age—and where to release the cranes remain unresolved. One option is to release adult birds, but the disadvantage of this is that it is highly unlikely that any crane that did not travel down a southward migratory route in its first six months of life would ever thereafter find its way, north or south, to the whoopers' tiny breeding or wintering grounds.

Reinserting captive-bred birds into a migratory route—whether the established one or a new one—may be the most difficult task of all. Wildlife managers in the United States tried for more than a decade

Share the Thrills of Exploring Outer Space!

$\$229^{95}$ f.o.b. Hartford, Conn.
$15 Crating Charge

All DYNASCOPES, including this superb RV-6, 6-inch available on easy terms!

Now it's easy to join the thousands of serious amateurs who have discovered the excitement of exploring our mysterious universe. Your enjoyment begins right from the start, yet the challenges and rewards go on for years! And it's a hobby that can be shared at modest cost.

Choose From Many DYNASCOPES®

Picking a telescope to fit your needs and your pocketbook is simple when you select a DYNASCOPE — the same instruments used by more than 150 schools, colleges and observatories — and your satisfaction is guaranteed by a full-refund warranty.

FASCINATING GUIDE YOURS FREE!

Read these valuable facts before buying any telescope. Mail coupon or postcard for your complimentary copy of this helpful guide.

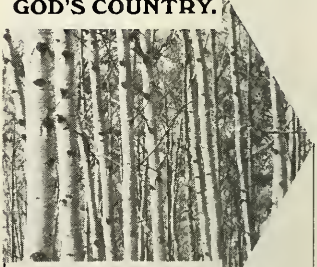
Criterion Manufacturing Co.
620 Oakwood Ave., W Hartford, Conn. 06110

® TM Registered U.S. Pat. Office

CRITERION MANUFACTURING CO., Dept. NH-53
620 Oakwood Ave., W Hartford, Conn. 06110
Please send your free Telescope Guide.
Name
Address
City State

Dynascopes

A GUIDE TO GOD'S COUNTRY.



Wilderness Areas of North America
by Ann and Myron Sutton
Photographs by the authors

A reliable, up-to-date guide to planning wilderness trips in more than 500 still-primitive areas from coast to coast and from Panama to the Arctic. Where they are, how to reach them, what to see there. The most complete book of its kind, packed with facts and photographs, on the remaining wonders of this remarkable continent. $10.00

FUNK & WAGNALLS
666 Fifth Avenue, New York, N.Y. 10019

to transplant Canada geese to new wintering grounds on nine national wildlife refuges within their former range. Although more than 20,000 geese were moved, the project failed. The experience with geese suggests that moving fledged birds into new migratory routes is no easy matter; it may be impossible with cranes, for which there will never be the numbers needed for broadside releases.

Among the many complex prerelease problems is determining what kind of stressing and preconditioning captive-bred whooping cranes will need to succeed in the wild. But staff nutritionist John Serafin, staff veterinarian James Miller, and Gee foresee the need for it. In their work with masked bobwhites, young raised indoors in a brooder, where they are always dry, die in the first rainstorm when put outside. If, however, they are given increasingly heavy dousings with a hose, they adapt to this stress, and few die when rained upon.

Gee says that conditioning birds to one stress often will stimulate adaptational mechanisms that prepare them for others. Thus, stressing a bird with water might also adapt it to cold.

Because there are so few wild whooping cranes, Patuxent also must take care not to introduce to the wild via released captive stock, genetic, behavioral, or disease traits that could harm the wild birds. Patuxent has not been taking precautions to control or even identify family lines among potential breeders. Because records have not been kept of the parental nest location of each bird, there is no way to prevent inbreeding.

Wildness itself may be more than a collection of traits. It is conceivable that cranes reared in captivity, insofar as they have been tamed, can never become fully wild.

One proposed whooping crane release plan would, each spring, bring fertile eggs, hatchlings, or both, along with their parents, to large, fenced-in areas of Wood Buffalo Park. The parent birds, rendered flightless by pinioning their wings, could teach the young to care for themselves. Then, when the migratory urge came in autumn, the young, hopefully, would rise in the air, leave their parents, and follow the wild whooping crane families south—thus learning the migratory

The evening: special.
The mood: "don't go."
The enticement: Kahlúa Kups

Irresistible! Cups of fine chocolate that you fill with Kahlúa. Sip the drink, nibble the cup and start all over again. Because you deserve something nice. Cups, complete with foil servers, twelve to the box, 3 boxes for $7.00; minimum order, 3 boxes. Shipped postpaid. Sorry, no C.O.D.

Kahlúa 53 Proof Coffee Liqueur from Sunny Mexico. Maidstone Importers, 116 No. Robertson Blvd., Los Angeles, Calif. 90048
CHOCOLATE
KAHLÚA KUPS
KAHLÚA
LICOR DE CAFÉ
LIQUEUR
MEXICO

Strangely beautiful cruises to forgotten islands. Indonesia adventures. 5 to 14 days, 2 to 7 ports.

Sail from Singapore, Bali or Jakarta.

Throughout 1974, the elegant new m.s. Prinsendam weaves a magic spell to haunting places. Join her for cruises of 14, 10, 9, 7 or 5 days. It depends on how many of these exotic ports you choose: Singapore, Penang, Belawan, Sibolga, Nias, Jakarta, Bali, Surabaya. Rates from only $375 for 5 days, from $1050 for 14 days.

Or take a tour package (23 to 34 days) with one price for air and cruise fares, hotels, meals, everything. From $1995. See your travel agent or mail the coupon. The m.s. Prinsendam is registered in the Netherlands Antilles. Cruise fares based on per person, double occupancy, subject to availability.

Holland America Cruises, Pier 40 North River, N.Y., N.Y. 10014. Tel. (212) 620-5101 or toll-free at (800) 221-6657

160-PSB-C
You may never want to get off.

Holland America Cruises

Please send me your 1974 Singapore/Bali brochure.

Name____
Address____
City____ State____ Zip____
Travel agent____

world famed
GOSSEN
Luna-Pro®
SYSTEM CdS REFLECTED
and INCIDENT LIGHT METER

It's every kind of exposure meter you'll ever have to buy!

Just by itself, the Luna-PRO—with its extraordinary 2,000,000:1 sensitivity range—is the world's outstanding meter for reflected and incident light... brightest sunlight... candlelight... even moonlight!

To make it a SPOT METER, ENLARGING METER or MICROSCOPE METER is a matter of seconds with the optional lock-on attachments. The Luna-Pro is the only meter you'll ever have to buy!

SPECIFICATIONS: One-hand operation • Measures reflected and incident light (with built-in hemispheric diffuser) • For still and movie cameras • 30° light acceptance angle • single selector button for high and low range • Automatic "memory" needle lock • ASA 6 to 25,000; f/1 to f/90; 1/4000th sec. to 8 hours; Cine from 8 to 128 fps • EV – 8 to EV+24; .016 to 32,000 foot candles • Weighs only 7 ounces.

OPTIONAL ATTACHMENTS

VARIABLE ANGLE "Spot Meter" ATTACHMENT
MICROSCOPE ATTACHMENT
ENLARGING ATTACHMENT

At better camera stores or write for color brochure

KLING PHOTO COMPANY
P.O. Box 1060, Woodside, N. Y. 11377

DIVISION OF Berkey PHOTO INC

Nikon wants you to see better

Nikon prism binoculars start with world-famous Nikon optics, made from Nikon optical glass. Lenses and prisms for right and left barrels are precisely matched and collimated, and the optical parallelism of both barrels is verified.

That's why with Nikon binoculars you enjoy brilliant, sharp, full-field viewing without strain or fatigue, even for long stretches. Now, find out how little more it costs to see better, longer. At Nikon camera dealers and selected optical departments. Write for literature Folio 18, Nikon Inc., Garden City, N.Y. 11530. Subsidiary/Ehrenreich Photo-Optical Industries, Inc. EPI
(In Canada: Anglophoto Ltd., P.Q.)

Nikon Binoculars

route as they traveled. Removal of their parents just prior to migrating time might be an added inducement for them to follow the wild cranes south.

One objection to this plan is that whooping crane families usually remain closely knit throughout autumn, winter, and into the following spring. There is no evidence to suggest that a three-month-old fledgling would be drawn to wild foster parents or that they would accept it. Neither is there evidence that a lone adolescent could survive the intense territorial aggression between families that characterizes whooping cranes' winter behavior.

The difficulties inherent in this plan prompted a search for more effective release methods. Two considerations shape current thinking. One is that the primary goal should be the establishment of a second migratory band. Second is the simple realization that the wildness quotient of any captive whooping crane declines precipitously with age. It is highest in the shell. While fetal birds are not wholly indifferent to their surroundings—parental quackings heard through the shell have been shown to shape species identity in some ducks—the cranes' wildness quotient certainly is far higher at birth than it is the day after they first see light in a poultry incubator in Maryland.

These considerations have led to plans to use wild sandhill cranes to foster the whooping cranes. One plan is to carry whooping crane eggs north to the nests of sandhill cranes that breed in Canada and migrate in winter to the southern United States. The same insulated suitcases that carried the present Patuxent birds south into captivity could be used to carry their offspring north to freedom. There would be no nutritional problems, no need for stressing procedures, no transitional adjustments: the whoopers would be carried past all obstacles to the wild life while still tucked safely in their shells.

The hope is that the sandhill parents, relieved of their own eggs, would raise the whooping cranes, bring them south, care for them through their first winter, and then, as whooping crane parents might do, leave them to make their own way as yearlings the following spring. Hopefully, when their breeding time came, the young

The Mexican Collection

Smiling Face, Totonac Culture.
Scale replica 3¼″ high, including base.
An issue of 1000, $225.

Atlante from Tula, Toltec Culture.
Scale replica 4⅝″ high, including base.
An issue of 1000, $225.

Head from Palenque, Mayan Culture. Scale replica 3⅝″ high, including base. An issue of 1000, $195.

Acrobat of Tlatilco, Olmec Culture.
Scale replica 2⅞″ high, including base. An issue of 1000, $265.

Zapotec Urn, Zapotec-mixtec Culture.
Scale replica 4″ high, including base.
An issue of 1000, $305.

The Wrestler, Olmec Culture.
Scale replica 3¼″ high, including base.
An issue of 1000, $250.

Brielle
China
& Galleries

The Mexican Collection is a magnificent selection of replicas of famous art treasures from the permanent collection of the National Museum of Anthropology and History, Mexico City. Lunt Galleries has been authorized to produce these figurines, to scale, in sterling silver and 22K gold vermeil. Each is tarnish-proof and bears an engraved issue number on its base plate. This is truly a pleasurable investment in precious metals.

A full color brochure, complete with description and history of each piece, is available for $1. Brielle China & Galleries, in Brielle, New Jersey 08730 (201) 528-9412. Master Charge, Bank Americard, American Express accepted. Charge accounts invited.

A world tour in one country.

PEY
satour
FREE
RSA

The greatest variety of wildlife in Africa.
Kruger National Park. Ostrich farms.
Tropical fruits. Gracious vineyards.
18 000 species of flowering plants.
738 kinds of indigenous trees.
Dazzling beaches.
Snow capped mountains.
Panoramic scenery. Gold, diamonds.
Sophisticated cities. International hotels.
Luxury transport. Endless summers.

Many places have some of them.
Only one place has them ALL . . .

SOUTH AFRICA

Send now for your free 52-page full-colour booklet "Discover the RSA", it'll show you visiting South Africa is an experience you can't afford to miss.

South African Tourist Corporation.
• 610 5th Avenue, New York, New York 10020
• 9465 Wilshire Blvd., Beverly Hills, California 90212
• 20 Eglinton Ave. W., Toronto, Ont. M4R 1K8
or ask your local travel agent for a free copy.

would be primed to return to the sandhill crane nursery from which they fledged.

Important questions need to be answered: Will sandhills accept the whooping cranes? Will whoopers thrive on the sandhills' more vegetarian diets? Will they recognize themselves as whooping cranes and seek like mates, or will they imprint on their sandhill parents and attempt wasteful hybrid alliances?

A more direct experiment is proposed by crane specialist George Archibald, a director of the International Crane Foundation. He points out that captive propagation of whooping cranes could be eliminated entirely, thereby wholly bypassing Patuxent. He proposes that whooping crane eggs be moved directly from Wood Buffalo Park to sandhill nests in Canada, Wisconsin, or Idaho. There is talk that such a maneuver may be tried next spring in Idaho.

Erickson and his associates claim they have worked out virtually all of the techniques needed for raising and breeding whooping cranes for release to the wild. This seems optimistic. They have not resolved their central problem. They have been unable to seduce, induce, or coerce any two of their captive whooping cranes into producing a viable egg, although the two 1967 birds are seven years old, presumably old enough, and two others at Patuxent are older.

As a result of Patuxent's management, the die may well have been cast against all birds now held captive. Because all of the whooper young were treated essentially alike—no effort was made to create parallel but different experimental tracks from birth to breeding—alternative options are lacking. It is only within the past year that an attempt has been made to correct this situation.

Erickson lays great stress on the head count, which was severely affected by 1971's unprecedented losses. But younger workers at Patuxent believe that the development of maintenance and propagation techniques is far more important than individual losses. The Patuxent group is certainly trying to maintain the birds. But based on the record, it is hard not to concur with Knoder when he says: "I'm just not convinced that everything has been done that could be done."

A paramount need according to virtually everyone, outside or inside Patuxent, is resources: expert manpower, buildings and equipment, maintenance—in short, money.

But is money the only problem? It seems not. The impression left by talks with many knowledgeable persons is that confusion and cross-purposeful activity is the norm at Patuxent, not the exception. The facility has only five full-time resident scientists who must hurry from one responsibility to the next—diet, housing, heat, disease—and from one animal to the next—cranes, masked bobwhites, Puerto Rican parrots, néné geese, and a dozen other endangered birds and mammals. The problem would seem to be, not one of effort or dedication, but of management and planning, as well as of money.

"We're doing a little bit on a lot of projects, and not getting anywhere with any of them—or, at least, not far enough," Gee says. "We do not have a program approach. We do not have systematic programming."

If Gee is correct, Patuxent's endangered wildlife program is organizationally as well as financially troubled.

Despite Erickson's insistence that there is value in keeping all propagation of endangered species at one research station, under the care of a common staff, many of his colleagues feel that the job is too big. They feel that either at Patuxent or somewhere else—perhaps in an area where the climate and soil are more healthful for cranes—a center should be started to deal exclusively with whooping crane propagation, while other centers, at other locales, are given responsibility for other species.

This suggestion has a precedent in federal support and management of research on human diseases. The United States, through the Department of Health, Education, and Welfare, expends billions annually on research grants and contracts. Indeed, Erickson has spoken of his own hope that Patuxent will one day be able to let contracts for endangered species research—perhaps by the end of the decade. If, however, the present paralysis at Patuxent is even half as bad as it seems, then the time to start farming the work out seems to be now, not later. ☐

Irish Mist
Liqueur

HEATHER HONEY.
A BEAUTIFUL IDEA FOR A LIQUEUR.

For over 700 years we've been taking the sweetest, most natural thing on earth and making it part of a fine liqueur. Imported Irish Mist®

We use just a touch of pure heather honey. So it doesn't sweeten, it mellows Irish Mist's deep rich taste.

Discover what a beautiful idea it is.

Antique jeweled bee: James Robinson, Inc., N.Y.
Imported Irish Mist® Liqueur. 80 proof.
©1974 Heublein, Inc., Hartford, Conn., U.S.A.

Getting offshore

It takes time. The Exxon gasoline you're filling up with today may have come from an oil field we started looking for 8 years ago.

Geological survey. Eight years ago, Exxon began to explore a piece of acreage 75 miles out in the Gulf of Mexico.

Our geologists examined rocks from the bottom of the Gulf and along the shoreline. They used special devices to locate possible oil-bearing rock thousands of feet below the seafloor.

From this information, they created a vertical "picture" of the rock layers to find strata that looked promising.

These studies can take very little time, or up to six years. This one took four.

In 1970, convinced that the chances of finding oil were good, Exxon bought the rights to drill exploratory wells. This was the only way we'd find out for sure if there really was oil there.

Exploratory drilling. We started drilling for oil in mid-1971. To do it, we used a mobile drilling rig. The cost of leasing and operating this rig was $24,500 a day.

Working round the clock, it took us 25 days to drill the first well. It was 8,500 feet deep—and we discovered gas, but no oil.

We then drilled a second hole. This time, we hit oil. To find out how big the field was, we drilled several more wells. They outlined the size of the field and confirmed that oil was down there in commercial quantities.

Exploratory drilling can often take as long as five years. We were lucky. It had taken us just two.

The next step was to design and construct the oil-producing platforms which would replace the mobile rig. These huge platforms would be anchored to the seafloor directly over the field.

Platform construction and installation. We started building the twin drilling and production platforms in 1972. Construction took 16 months.

Each offshore platform has to be built specifically for the area it will work in. We have to take into account water depths, wind and wave action, earthquake possibilities, and other factors. This is why a platform built for the relatively calm Gulf will be different from one built for the fierce North Sea.

Our next step was to tow the steel structures out into the Gulf. We then sank them in place in 235 feet of water, and anchored them with pilings driven into the seafloor.

Then we added the platform decks. These included the crew's quarters as well as facilities for producing the oil.

oil to you.

EXXON
Happy Motoring!
1974

Production drilling. When everything was shipshape on the platform in early 1973, we began to drill the first production well that would actually bring the oil to the surface. We drilled four wells in 1973, and seven more in 1974.

Most of the wells are drilled straight down for a few hundred feet, then slanted away from the platform base. This greatly increases the area that can be tapped from one platform.

Frequently, we use several platforms in developing an oil field. These platforms, like the individual wells, must be placed carefully to insure that the oil is recovered as efficiently as possible.

Underwater pipelaying. While the platform crew was drilling the production wells, bargemen and welders were busy laying the underwater pipeline that would take the oil from the platform to shore.

Aboard a pipelaying barge, coated sections of pipe move along a track and are welded together. Then the welds are inspected by X rays. The joints are given the same protective coating as the pipe and the continuous pipe is slipped down onto the seafloor.

To get the oil to shore from our new producing platform, we had to lay a section of pipeline that linked our platform with a main pipeline nearby. If this main artery had not existed, and we had to lay one, then the entire pipelaying job might have taken several months. As it was, we did it in one month.

Refining and delivering to you. The crude oil that started coming to shore this year from our production platform in the Gulf was carried by another pipeline to a nearby Exxon refinery.

Gasoline made from this crude was shipped to Exxon service stations through product pipelines and by tank trucks.

And the gasoline you're filling up with today may have come from that field we started looking for eight years ago.

U.S. offshore oil now supplies 11% of America's needs. Within ten years it will have to supply considerably more.

This is why Exxon is looking today for the oil you'll be needing in the 1980's.

EXXON

SYD RADINOVSKY

The Shell Game

For the hermit crab, the rule is eviction, evacuation, or chance. Protection to live on land is the prize

by Syd Radinovsky and Alex Henderson

In many groups of animals, a variety of anatomical structures serve as protection from predators and the elements. The shell is one common example of an effective physical adaptation for survival. Encased in skeletal armor, turtles and snails function in relative safety, vulnerable only to a few specialized predators and unusual environmental disturbances.

Not as common, but almost as effective, is the secondhand use of a shell by another animal for protection. Terrestrial hermit crabs, such as those that scuttle about on the sandy beaches of the Florida Keys, are safe from desiccation, temperature extremes, and most predators because they have adapted to empty gastropod shells (primarily tulip shells) as an external line of defense.

The abdomen of the terrestrial hermit crab is soft and vulnerable, but by inserting this part of its anatomy into a suitable empty gastropod shell, the crab protects it from the grasp of potential predators and the deleterious effects of direct exposure to hot, dry air. A suitable shell is one that enables the crab's entire body to be drawn into it, so that the animal's large claw, or cheliped, serves as a kind of operculum—sealing off the crab's vulnerable parts within.

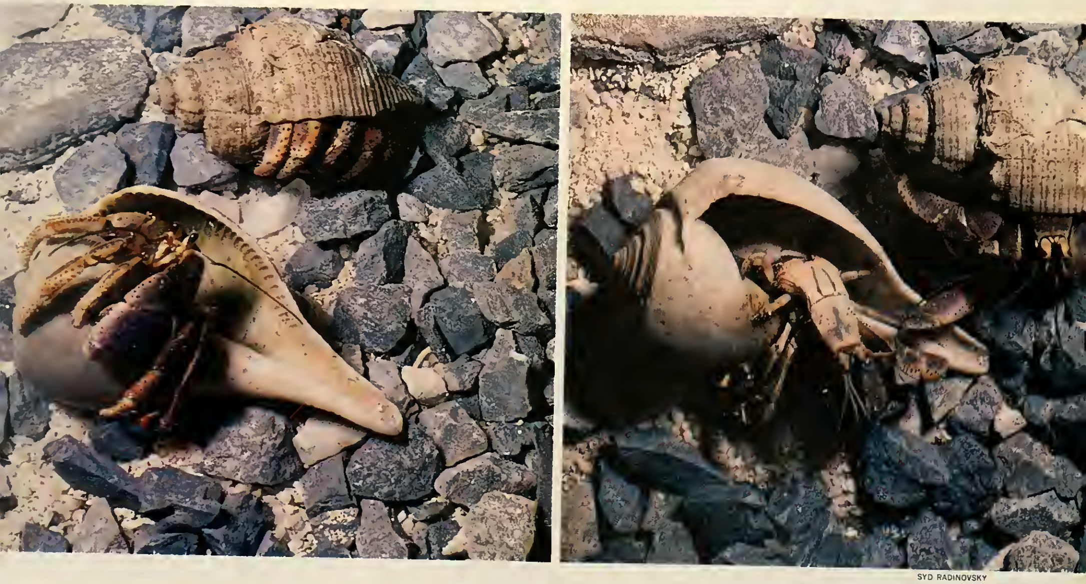
To a soft-bodied crab the protective benefits of inhabiting the hard shell of another creature are obvious. This adaptation also might have played a significant role in the evolution of terrestrial hermit crabs from their marine ancestors. The evolutionary pathway may have been tied to the availability of empty shells in the highly competitive and, perhaps, crowded ocean habitat. Conceivably, shell selection pressures in the seas—due to interspecific competition among the many marine hermit crabs and other animals—led to the colonization of an available ecological niche on shore, where interspecific competition was minimal and empty shells were plentiful.

On Boot Key, an island off southern Florida where we conducted studies on the population dynamics of terrestrial hermit crabs, an abundant, constantly replenished supply of small gastropod shells litters the beaches. Purple-clawed hermit crabs (*Coenobita clypeatus*) by the tens of thousands inhabit these beaches in their adopted gastropod armor. With fewer predators on land than in the sea, and a seemingly sufficient supply of empty shells, other factors—such as food resources—would seem to be the primary limiting force on the terrestrial hermit crab population. We soon discovered, however, that the number of suitable shells decreases as a crab's size increases.

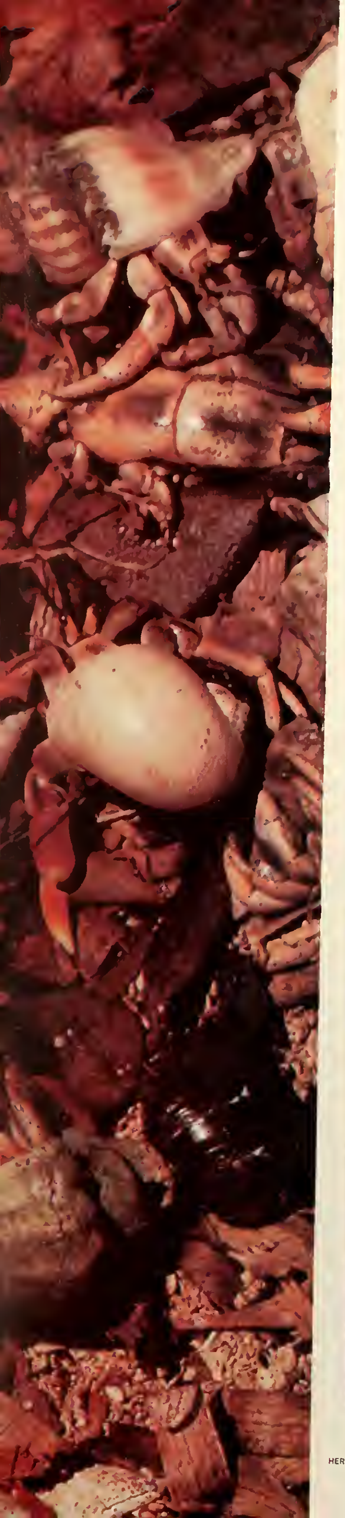
Our studies revealed a relative scarcity of empty medium- to large-sized gastropod shells on the beaches. Since hermit crabs require larger shells as they grow, the availability of a range of shell sizes may well be the most important factor in population size. Our research has focused on intraspecific competition for suitable shells as a key survival component in the behavioral repertoire of these gregarious crabs.

We set out to discover how shell selection among the purple-clawed

A multitude of newly hatched offspring drift by a female hermit crab in the shallow water of a coral depression, left. As terrestrial adults, the crabs will have to acquire empty shells to protect themselves. In the series below, a crab, designated No. 44 by the research team, secures a larger shell by evicting its occupant, shown in the last frame abandoning its home.



SYD RADINOVSKY

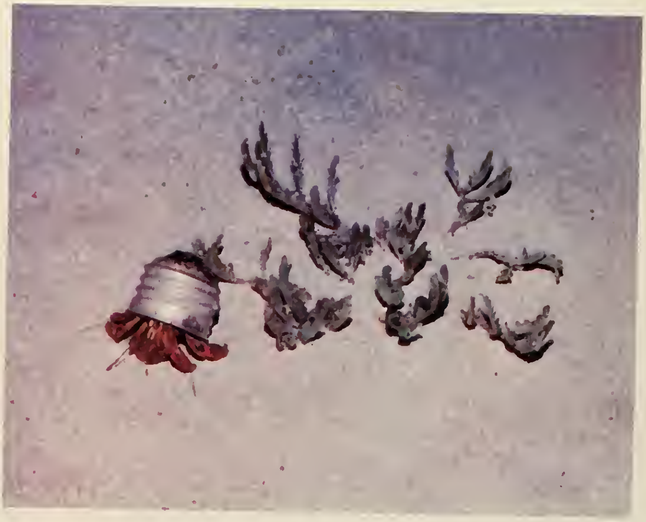


hermit crabs took place and how shells were exchanged between individuals requiring different sizes. We found that hermit crabs obtained suitable shells in three ways. First, shells were encountered and appropriated simply by means of random wanderings and chance findings. Second, a mutually beneficial exchange often occurred when one crab in need of a larger shell interacted with a smaller individual housed in a shell too large for it. And third, shells were made available during group exchanges in which one switch would trigger a series of switches involving a progression from large-, to medium-, to small-sized crabs and shells.

The majority of the shell exchanges that we observed involved interaction between two crabs. Exchanges occurred mainly in two ways. One was forceful eviction, in which a large crab in a tight-fitting shell overpowered a smaller one in an oversized shell and forced it out. The other was a peaceful evacuation by a small, passive crab after a stereotyped sequence of events.

In both situations the larger aggressor approached the smaller crab, and both moved their antennae and antennules. Upon contact, the antennules moved over the passive crab's shell, shell aperture, and exposed cheliped. Following this, the aggressor—using its chelipeds and first and second pairs of ambulatories—methodically and rhythmically rocked the smaller crab's shell back and forth. Such a rocking movement might provide the aggressor with information

A mass exchange, left, enables most of the crabs to obtain better fitting shells. One crab, however, is often left with a wrong-sized shell. In a pinch, below, the base of a broken light bulb suffices as protection from predators and the elements.



JOAN ANGSTADT

HERB SENFT

Purple-clawed hermit crabs climb trees to feed on mangrove sap, a food resource they share with cockroaches.

about the size of the passive crab in its shell: conceivably the aggressor could detect a smaller crab's size as it bumped against the inner sides of its shell.

If the passive crab were much smaller than the aggressor, it would not be occupying a very suitable shell, and the drive to resist an exchange might be low. This appears probable because in most cases in which the passive crab occupied a suitably sized shell, it resisted eviction. This usually led to a struggle in which the aggressor, using mainly its chelipeds and first ambulatories, attempted to pull the crab out of its shell. This had one of three results: the passive crab lost a large cheliped and subsequently abandoned its shell or it lost no appendages but abandoned the shell or it maintained control of its shell.

In the majority of cases, which involved no aggressive behavior other than initial investigation and rocking movement followed by a peaceful evacuation, the exchange appeared to be mutually beneficial. This was ascertained by the typical righting movements and normal walking behavior of both crabs after an exchange.

On several occasions we observed mass, or group, shell exchanges. In one aggregation of thirteen hermit crabs, a large individual approached a smaller one in an oversized shell, and after the typical rocking movements, the smaller crab left its shell. These rocking movements appeared to activate the other crabs. The large crab took possession of the smaller one's empty shell, but before a possible mutual exchange could take place, another crab left its shell and entered the larger crab's just-vacated one. A smaller crab then left its shell and took up residence in the third abandoned shell. There was a chain reaction as the other crabs, in musical-chairs fashion, abandoned their shells and selected apparently more suitable ones. When the mass shell exchange had been completed, one moderate-sized crab was left with a shell that was too small. It eventually adopted the undersized shell, which provided protection for only the posterior part of its abdomen. Such aggregations may be one way of insuring that most of the crabs will have a suitable or nearly suitable shell when needed.

Many crabs obtained their first shells by random wandering and chance finding, but this method was not important thereafter. Shell exchanges between bigger and smaller individuals were the predominant mode of securing adequate protective housing as the crabs matured.

We observed a most unusual shell exchange on Boot Key. A hermit crab was measuring an empty shell that had a larger external surface, but as it turned out, a smaller internal volume than its own shell. Nevertheless, the crab abandoned its shell and squeezed into the new one with some difficulty. The transfer was not smooth, taking about twice as long as usual. After righting itself, the crab, walking with apparent difficulty, turned toward the shell it had just abandoned. It measured the old shell thoroughly, externally and internally, and then measured the external surface of the shell it now occupied. Then, after more investigation, it finally transferred back to its original shell, righted itself, and walked away.

Shell-less hermit crabs and individuals in tight-fitting shells exhibit greater shell-searching behavior than those inhabiting a suitable shell. At first, visual stimuli apparently are involved in bringing crabs together or in locating empty shells. Tactile stimuli then come into play.

The crabs on Boot Key showed a preference for several species of tulip shells. Other preferred shells included tritons, periwinkles, turbans, star shells, West Indian top shells, and several small species of Muricidae. In a pinch, crabs will use any object with concavities that might afford some protection—empty cartridge shells, broken bottle necks, and light bulb bases.

Many other arthropods occupy the same habitat as the terrestrial hermit crab, but only cockroaches appear to compete with them for food. Both climb mangrove trees and feed on the sap in what appears to be peaceful coexistence. Scorpions, black widow spiders, wolf spiders, orb weavers, tiger beetles, earwigs, and dragonflies are all predators that are present in the area, but they pose no threat to the crabs. Fiddler crabs are plentiful, but they occupy a different ecological niche. In our study area the only possible predators on hermit crabs are large land crabs, raccoons, and sea birds.

Our studies at Boot Key indicate that the scarcity of moderate- to large-sized shells results in shell exchanges either on a one-to-one basis or in mass group exchanges. Intraspecific competition for suitable shells thus plays a far greater role in regulating the population size of terrestrial hermit crabs than does interspecific competition. Crabs occupying ideal, satisfactory, or less than satisfactory shells are subject to aggressive interactions from crabs in ill-fitting shells. The net result of these interactions is a constant competitive activity that reduces the adequacy of shell fit in some while improving the shell fit in a majority of crabs.

This social behavior has evolved in these animals to ameliorate the aggression inherent in the necessary shell exchange; and this, too, has a decided survival value for the species.

Securing a properly fitting shell is a necessity for the soft-bodied terrestrial hermit crab. A shell that is too large will not adequately protect its tenant from predation, desiccation, temperature extremes, and mechanical abuse. A shell that is too small will hamper efficient movement in the crab's search for food and a mate and cover only a portion of its vulnerable anatomy. The number of medium- to large-sized shells available to the crabs as they grow to reproductive age is probably the key factor controlling the population of the purple-clawed hermit crab. ☐

HERB SENFT

Celestial Events

by Thomas D. Nicholson

Sun and Moon The sun is moving through Sagittarius at this time of year, marking the southernmost part of the sky that it reaches. This keeps it quite low for viewers in the Northern Hemisphere. The sun climbs only about one-third of the way up our sky at noon and spends less than eight hours of the day above our horizon. The earliest sunset occurs on December 10 or 11; the shortest day of the year on December 22; the latest sunrise about January 6 or 7. And perihelion, the point at which the earth is nearest the sun of any time during the year, occurs on January 2.

The full moon of December 28, on the other hand, is the highest and brightest of the year, spending fifteen hours in our sky and reaching as high at midnight as does the summer sun at noon. After first-quarter moon on December 21, you will see the moon climb higher with each passing night. After full moon, the waning gibbous moon will move lower nightly and also move into the morning sky. Last-quarter is on January 4; new moon on January 12.

Stars and Planets Jupiter and Saturn are on the evening star map this month: Jupiter in Aquarius, in the southwestern sky in the early evenings; Saturn in Gemini, above the eastern horizon early at night. Jupiter sets well before midnight, but Saturn stays all night, moving up to the south around midnight and then into the west, where it remains until dawn. The brightest stars of the winter constellations accompany Saturn across the sky.

Venus and Mercury are also evening stars, but they are below the western horizon at the times represented by the star map. The chances of seeing either one are negligible; they set too early in the twilight. Mars is off the map in the morning sky. It rises shortly before dawn but is not very bright. You may find it as a morning star low in the southeast in early morning twilight. The moon will help in locating it on the mornings of January 9 and 10.

December 18: The moon is at apogee, farthest from earth.

December 19: Mercury passes the sun from right to left (superior conjunction) and enters the evening sky.

December 19–20: The bright object nearest the moon these evenings is Jupiter: to the left (east) of the moon on the 19th; to the right (west) on the 20th.

December 22: The sun arrives at the winter solstice at 12:57 A.M. EST, and winter begins in the Northern Hemisphere. The weak, relatively little-observed Ursid meteor shower (about fifteen meteors per hour) reaches maximum.

December 29: Saturn is near the moon all night, separating slowly from it as the moon moves off to the east (left).

December 30: The moon is at perigee, nearest earth.

January 2: The earth is at perihelion, nearest the sun.

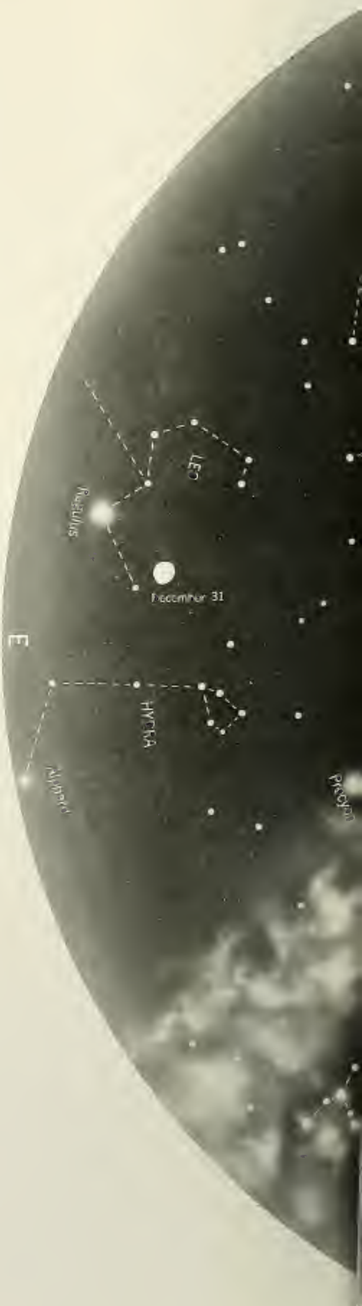
January 6: Saturn reaches the point in the sky opposite the sun. The planet is now above the horizon all night long.

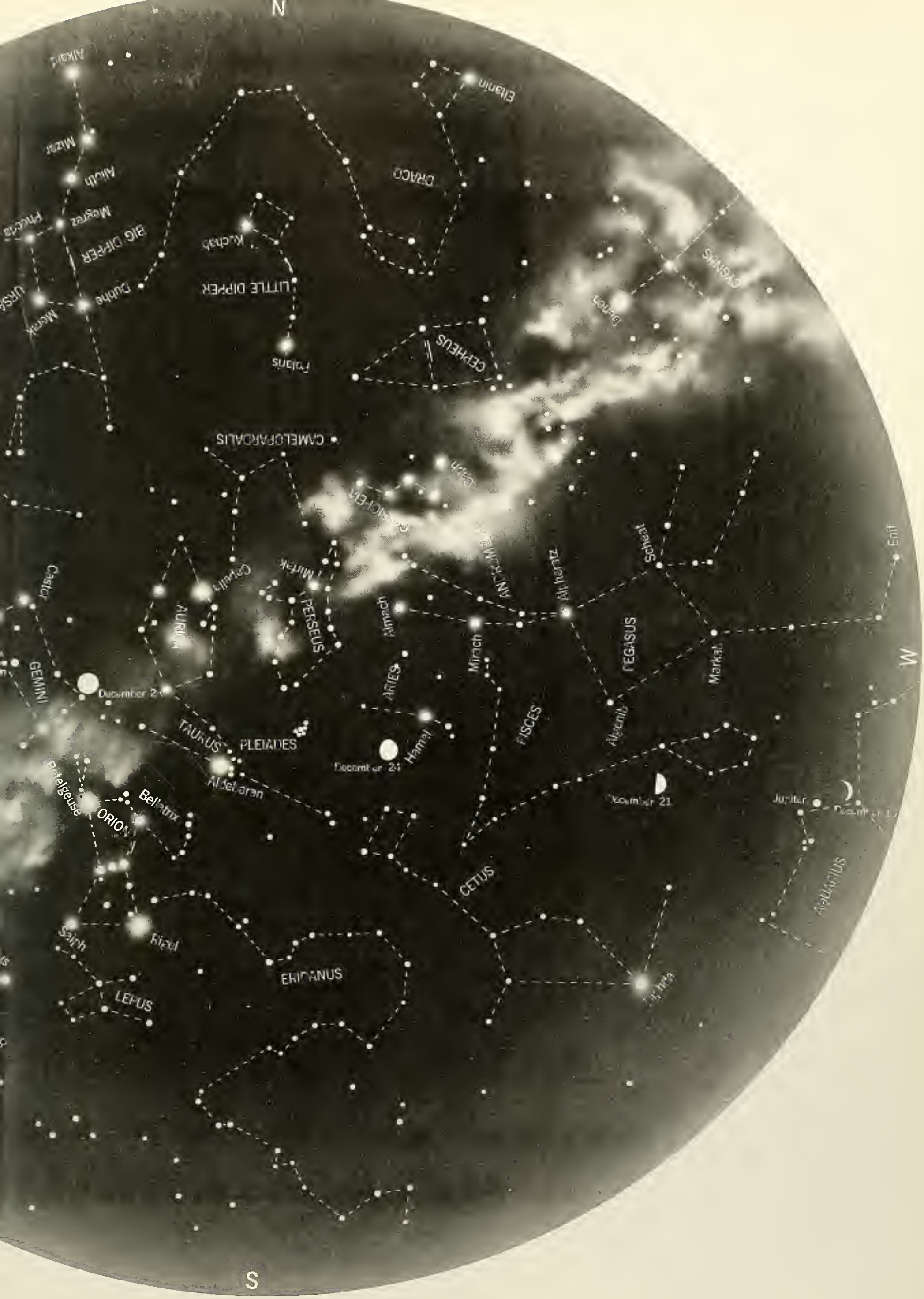
January 9–10: Mars is below the rising crescent moon on the morning of the 9th, above the moon and to its right on the 10th.

January 13: The early crescent moon passes Mercury and Venus today, but all three objects will be too low in the southeast at dusk to be visible.

January 15: The moon is again at apogee.

★ Hold the star map so the compass direction you face is at the bottom, then match the stars in the lower half of the map with those in the sky near the horizon. The map is for 10:20 P.M. on December 15; 9:15 P.M. on December 31; and 8:20 P.M. on January 15; but it can also be used for about an hour before and after these times.




N
Alkaid
Mizar
Alioth
Megrez
Phecda
BIG DIPPER
Dubhe
Merak
URSA
Eltanin
DRACO
Kochab
LITTLE DIPPER
Polaris
CEPHEUS
CYGNUS
Deneb
CAMELOPARDALIS
CASSIOPEIA
Caph
Castor
Capella
Mirfak
PERSEUS
AURIGA
ANDROMEDA
Alpheratz
Scheat
Almach
Mirach
PEGASUS
Markab
Enif
W
GEMINI
December 24
TAURUS
PLEIADES
ARIES
Hamal
December 24
PISCES
Algenib
December 21
Jupiter
AQUARIUS
Aldebaran
Betelgeuse
Bellatrix
ORION
CETUS
Saiph
Rigel
ERIDANUS
Diphda
LEPUS
S

'Twas the eve of Saint Nicholas
and all through the town,
Not a sound could be heard
as snow filtered down.
The children all waited
in trembling and fear,
In hopes that Saint Nicholas
soon would appear.
Then out of the night
there arose such a clatter,
People sprang to the street
to see what was the matter,
When what to their wondering eyes
should appear,
But devils and demons
coming anear.

In the mountains of Styria, a province in southeastern Austria, ancient pre-Christian customs remain an integral part of the folkloristic life of the people. Bad Mitterndorf, a village high in the mountains at the eastern end of the Central European Alps, is the only place where the eve of Saint Nicholas Day is still celebrated in its original, mysterious manner.

The stark winter comes early in these parts. Centuries ago, when the people of the area were mainly pastoralists, they had to slaughter many of their animals at the beginning of each winter because there would not be enough hay to sustain the livestock through the cold months. The slaughter included sacrifices to ancestors and other spirits.

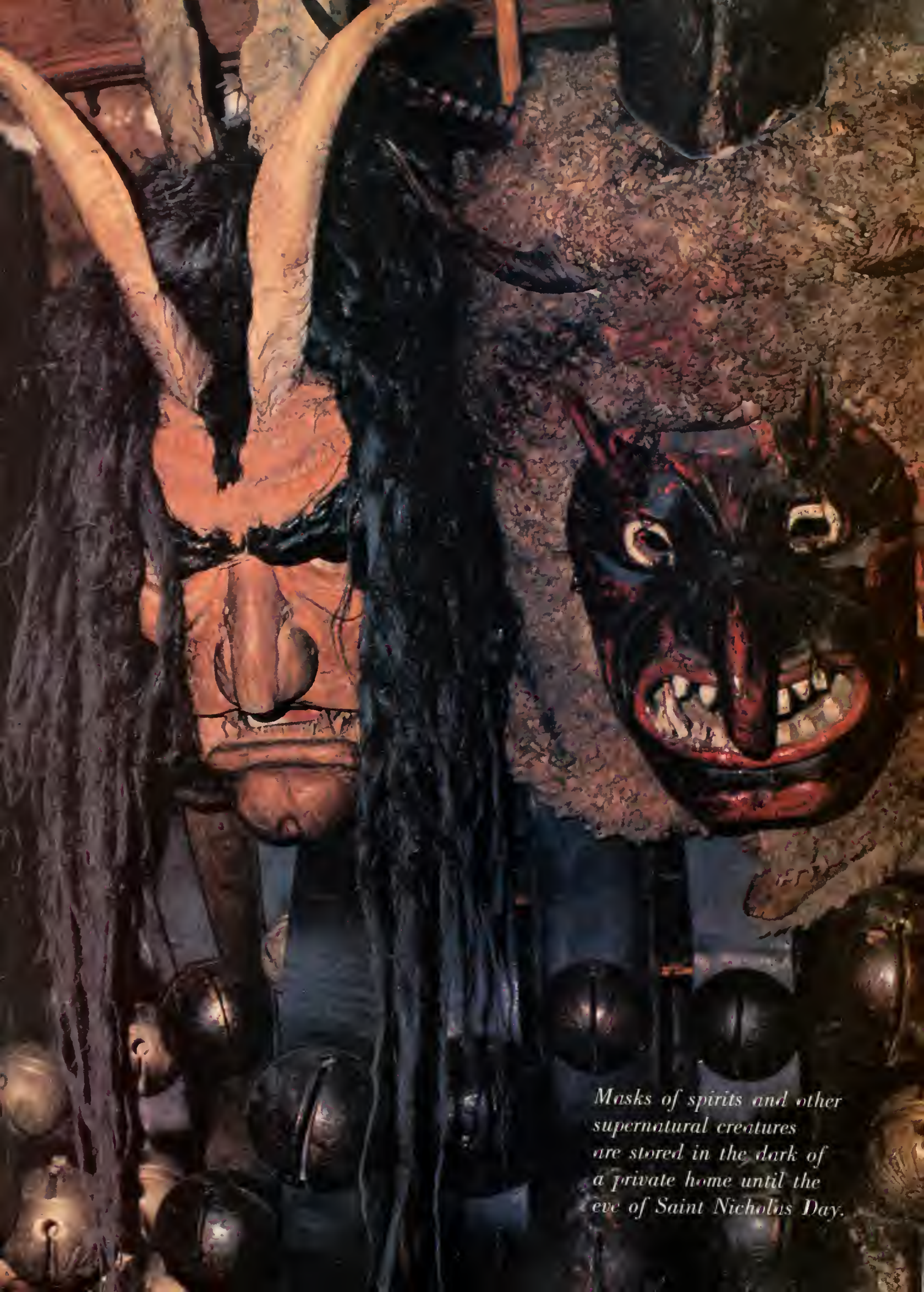
After Christianity, the sacrifices to the spirits evolved into gifts to the children, and one night every year the supernatural beings, accompanied by Saint Nicholas, the patron saint of children, took to the streets.

Usually by December, the land lies under a cover of several feet of snow; later in the season snow sometimes rises to the roofs of houses. At this time of year, the deep valley, surrounded by high mountains, fills with shadows by the middle of the afternoon. Soon the last rays of the sun cast an umber glow on the mountain walls that loom to the south. Night falls suddenly.

On December 5, the eve of Saint Nicholas Day, the streets of Bad Mitterndorf are deserted. The snow muffles almost every sound and a hollow quietude fills the valley. A conspiracy of emptiness comes out of the darkness, and from behind curtains, children stare out at the moving shadows cast by the swaying street lights.

The rattling of a chain from a nearby stable or the squeaking of a door—any inconsistent noise—brings fear and anticipation to everyone, especially to the children. Suddenly from afar comes a rattling and a stamping, and in the next moment a horde of wild creatures with horned masks charges around a building

Text and photographs by Rudi Haas



Masks of spirits and other supernatural creatures are stored in the dark of a private home until the eve of Saint Nicholas Day.

corner and down the main street, roaring and swinging chains and birch twigs from side to side and shaking bells that are attached to their furry bodies.

Outside the village they join the many other odd figures already gathered there. The children tremble and families get ready to watch as the strange procession moves through the village to the market square.

Creatures in straw costumes, each with two long, antennalike sticks on their heads, lead the procession. They walk in a stately manner and rhythmically crack their whips in a motion of sweeping the path. They represent cornfield demons, and their origin is unknown.

The medieval *Nachtwächter* (night watchman), with his halberd, lantern, and signal horn, follows the figures in straw. As he did in days long past, he calls out the night's safety warning. Next comes a rider on a white wooden horse, wearing a feathered headpiece and a fur coat. In northern European legends, riders of white horses were thought to possess supernatural powers of good and evil.

Saint Nicholas himself follows; walking by his side is his companion, known as Bartel. Bartel is dressed in furs and wears bells at his belt. On his back, he carries a whole basketful of gifts. In one hand Bartel carries birch sprigs with which he punishes bad children. Saint Nicholas rewards good children with gifts from the basket. With his long, sparkling white beard, mitre, red chasuble, and golden staff, his appearance is regal beside that of his unruly-looking companion.

In the fourth century, Nicholas was probably a bishop in Asia Minor. Although his life is not documented, his legend and popularity grew, and as early as the sixth century, he was already popular as a saint in the Eastern Church. He became the patron saint of sailors, children, travelers, the poor, trade groups, cities, and eventually, all of old Russia and several other countries. In the eleventh century, when Italian sailors reportedly brought his bones to Italy, his cult had already spread to the Western Church. His fame and popularity reached the Austrian Alps in the twelfth century.

Among the celebrants in the Bad Mitterndorf procession are a priest, an angel, and a figure personifying Death. Death has a white wooden skull, wears a black costume with a skeleton painted over it, and swings a scythe.

There are many others in the procession: a beggar with a crooked stick, the blacksmith who plays tricks, and a white she-goat that symbolizes fertility. A herd of devils representing the whole hierarchy of hell follows. They are ferocious, noisy, horned figures who chase people or flog with branches the bystanders who line the streets.

There is laughter, roaring, yelling, and the constant sound of bells and cracking whips. As the figures proceed, they disappear into houses where they give theatrical performances. At the end of each performance, the *Nachtwächter* blows his horn, and the procession reassembles and proceeds to the next stop.

At the market square, the straw men gather in a big circle, cracking their whips to a steady beat, while from a wooden platform, Saint Nicholas delivers a message to the audience and questions the children about their prayers and their behavior, rewarding them with some gifts from his companion's basket. Most of the children also receive presents the next morning, mostly fruits and nuts and pastries that look like Saint Nicholas or animals or devils.

On the stage in the square, the beggar calls for the priest, to whom he confesses his sins, putting his vices in as nice a light as possible. The priest then asks the beggar to renounce his sins.

"Oh no!" says the beggar. "I don't want to spoil my fun. It's too soon. I have time!"

But Death, who has been waiting in the background, .in a mechanical marionettelike movement, strikes him down with his scythe. The devils, confined to one corner where they have been making mock charges, now break loose with animallike movements, fall upon the victim, and drag him off the stage to hell. A few more devils appear on the stage with a special message that reinforces the Christian moral.

Later, the marketplace becomes a whirlpool of movement as performers and audience mingle and chase each other about. And then, almost unnoticed in all the activity, the creatures of the procession disappear. They remove their costumes and masks and return them to the house of the Strick family, where they will be stored until the next year, when unknown men, selected in secrecy, will again wear them on the eve of Saint Nicholas Day. □

The Taung Skull Revisited

Was this child a predecessor of man or a member of a hominid species that reached a dead end?

by Phillip V. Tobias

When a rock containing a small fossil skull came into the hands of Raymond Dart, a young Australian anatomist, half a century ago, man's ideas about his own evolution were destined to change. Excavated by a miner from a lime works at Taung, a village about 400 miles southwest of Johannesburg, South Africa, the skull was embedded in calcified cave earth, or breccia. It reached Dart at the University of the Witwatersrand in Johannesburg, and for six weeks he chipped away the rock until—just before Christmas, 1924—he exposed the nearly complete skull of a child. With the uncovering of this fossil, Dart opened a series of controversies about human evolution that continues today.

The Taung fossil included the greater part of an endocranial cast (the impression of the interior of the brain case), a superbly preserved facial structure including both jaws, all twenty of the milk teeth, and the first of the permanent teeth to erupt—the upper and lower first molars.

Nothing like it had ever before been discovered. Scientists had dreamed of finding a "missing link," a fossil that might show features intermediate between those of apes and men. To Dart, the Taung skull showed just such features. It was a hitherto unprecedented amalgam of apelike and manlike features. He called the species to which the creature had belonged *Australopithecus africanus: austral,* meaning "southern"; *-pithecus* from the Greek *-pithekos,* meaning "monkey" or "ape."

His claims for the discovery were relatively modest as the wisdom of hindsight now shows. The fossil's structural features led Dart to claim that the creature was a higher primate belonging to an extinct ape species that had a number of features similar to those of man. The environment of Taung, the treeless verge of the Kalahari Desert, and the associated animal remains led Dart to ascribe to *Australopithecus* a way of life different from that of any extant forest-dwelling ape and approaching more closely that of early man.

A storm of controversy greeted the announcement, and his claims evoked arguments that were not settled until the lapse of twenty-five years and the discovery of many new australopithecine fossils in South and East Africa had produced a most compelling body of evidence. Yet, as early as 1925, Dart had had the insight, the vision, and the courage to assert that *Australopithecus* from Taung vindicated Charles Darwin's 1871 claim that Africa would prove to be the cradle of mankind.

In 1925 the prevailing climate of opinion about man's descent pointed to Asia, not Africa, as the birthplace of mankind. Just thirty-five years earlier, a Dutch surgeon and anatomist, Eugène Dubois, had found a fossilized skullcap, a thighbone, and sundry other remains in central Java, to which he had given the name *Pithecanthropus erectus,* upright ape-man of Java. The discoveries made by Dubois in Java between 1889 and 1895 helped to establish the belief that Asia had been the scene of homonid emergence.

At about the same time, China began to yield some tantalizing relics. Among various fossil fragments found in a Chinese drugstore, one specimen had been recognized as a fossil hominid tooth and traced to a cave near the village of Choukoutien. This led paleontologists to excavate the cave where they found fossil hominid bones, thus making China a possible source of human ancestors. The work of Davidson Black and, later, of Franz Weidenreich was subsequently to prove the former existence of Peking Man (*Homo erectus*), a close relative of Java Man.

The preconceived theories of man's origin were heavily weighted against the suggestion of the little-known young anatomist from the unlikely end of Africa. Not only was Dart's discovery made in the wrong part of the world; it was the wrong kind of creature.

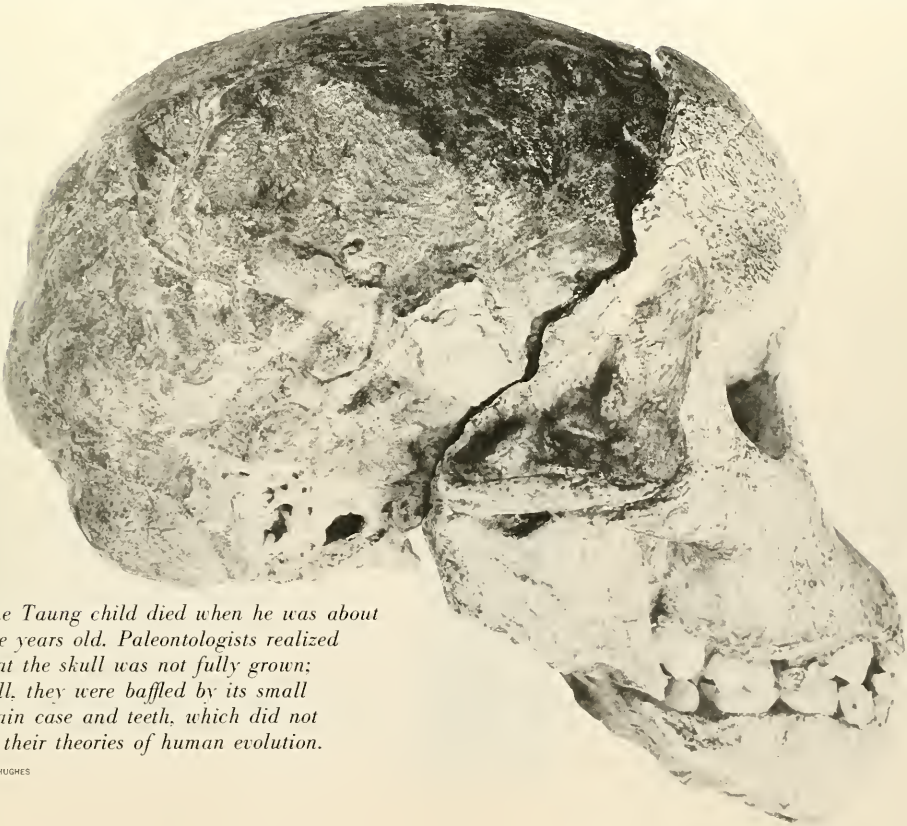
Scientists of the time believed that the progressive enlargement and increasing complexity of the brain had been the chief element in the advance of some ancestral apes toward hominid status. The evolution of the teeth and the locomotor apparatus (pelvis, lower limbs, limb joints, ligaments, and muscles) supposedly evolved at the same rate as did the brain. Fanciful illustrations of slouching cave men with large teeth and projecting canines have perhaps not done justice to these imagined creatures. Presumably the spark of human genius was already present in these forefathers despite the gore-dripping manners and the "brutish" and "beastly" habits commonly ascribed to them.

Few propagated the view of the primacy of the brain more assiduously and convincingly than Dart's old teacher and former fellow-Australian, Sir Grafton Elliot Smith. As head of the Institute of Anatomy at University College, London, Elliot Smith had played a major role in giving Dart his first serious research opportunity in England and in getting a fellowship for him to study in the United States. Undoubtedly, Elliot Smith did much to inculcate in Dart the view that the brain was the focus of evolutionary advancement of both primates and man.

But when the principal actor strode onto the stage, the audience gasped. He was not at all what had been expected. The Taung skull had a *small* brain of apish dimensions, and its canines did not project like an ape's but were reduced like a human child's. The confusing creature's posture was appreciably more erect than that of modern apes judging by the relatively forward position of the orifice in the base of the skull through which the spinal cord passes. The Taung individual's teeth as well as its locomotor apparatus appeared to be in the vanguard of hominization, while the brain itself was lagging—at least in size.

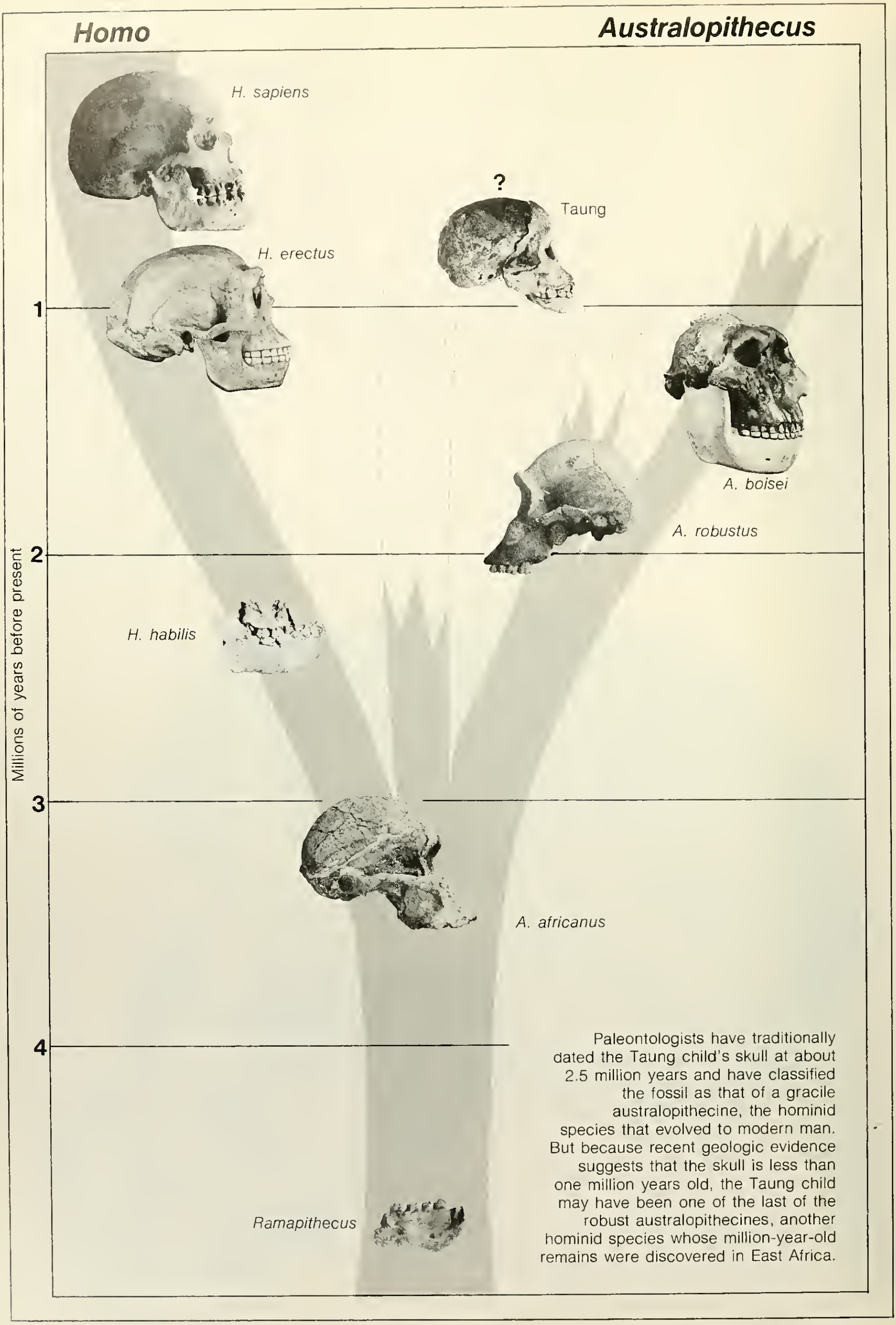
The fossil from Taung forced Dart away from the teachings of his old mentor and to the realization that brain enlargement was not the first step in human evolution. Of course, size is not everything, and Dart drew attention to features of the endocranial cast that pointed to a humanlike reorganization of the brain substance itself. It looked more like a miniature human brain than an immature ape brain.

With the Taung fossil defying all expectations, Dart's claims proved a



The Taung child died when he was about five years old. Paleontologists realized that the skull was not fully grown; still, they were baffled by its small brain case and teeth, which did not fit their theories of human evolution.

A.R. HUGHES


Homo
Australopithecus
H. sapiens
?
Taung
H. erectus
1
A. boisei
A. robustus
2
Millions of years before present
H. habilis
3
A. africanus
4
Ramapithecus

Paleontologists have traditionally dated the Taung child's skull at about 2.5 million years and have classified the fossil as that of a gracile australopithecine, the hominid species that evolved to modern man. But because recent geologic evidence suggests that the skull is less than one million years old, the Taung child may have been one of the last of the robust australopithecines, another hominid species whose million-year-old remains were discovered in East Africa.

hard pill for most scientists to swallow and caused them to argue for decades over the merits and demerits of according hominid status to the species Dart called *Australopithecus africanus.*

While Dart's discovery forced him to defy the doctrines of the day, basing his claims on a child's skull made his mission much harder. The state of eruption of the fossil's teeth was typical of a six-year-old modern human or a four-year-old modern chimpanzee. Perhaps the Taung child was about five years old when he died.

Had the first *Australopithecus* discovered been an adult, Dart's task of convincing an incredulous world would have been far easier as the full characteristics of a hominid do not appear until puberty. Yet Dart read the signs of mankind in the child, while the rest of the world waited to be convinced by the discovery of an adult hominid.

The wait lasted twelve years. In 1936, Robert Broom, one of Dart's colleagues and supporters, discovered a skull of an adult *Australopithecus* at Sterkfontein, not far from Johannesburg. Later finds and analyses confirmed that the australopithecines were indeed on the pathway to hominization. Dart's own work suggested that these creatures began using and making tools, an ability that implies a dependence upon cultural activities. As well as biological inheritance by genes, *Australopithecus* was beginning to rely upon a social heritage, the passing of collective wisdom through teaching and example.

Today there are hundreds of specimens of early hominids that have been wrested from the earth at five locations in South Africa, three in Tanzania, six in Kenya, and two in Ethiopia. The total number of individuals represented by the growing stockpile of fossils now runs to several hundred. Fossil teeth alone number well over 1,000. Vertebrae, pelves, and limb bones have supplemented skulls and teeth. Our ideas about these early hominids become more complete every year. Already we know that more than one kind of creature existed.

Paleontologists are now able to compare specific bones of one fossil group with those of other fossil groups, later man, and apes. They can also study the form and size of the brains and the development of teeth.

The australopithecines had small brains and large premolars and molars. But even within this genus of the Hominidae, there are two or three species. One species had a light frame, slender muscles, a small jaw, and, in contrast, fairly large incisors and canines. This gracile species is usually called *Australopithecus africanus.*

Another australopithecine species, although probably not taller, was sturdier. Its front teeth were on the small side, but its molars and premolars were very large indeed; also its jaws were much heavier, its muscles more beefy, and its body weight almost certainly greater. To this robust kind of ape-man scientists have given the name *Australopithecus robustus.* In East Africa, the robust form reached such hefty and Herculean proportions that some regard it as representing another species called *Australopithecus boisei.* The two robust australopithecines, however, are fairly closely related to each other.

Specimens of another early hominid have features that distinguish them from *Australopithecus.* More particularly, their brain cases are enlarged (both absolutely and in relation to their medium-sized bodies) 50 to 70 percent above those of *Australopithecus africanus.* The associated limb bones suggest that they may have been even better adapted to standing upright and walking on two legs than was *Australopithecus.* There is evidence that although australopithecines began to use tools, this other early hominid was the first to make stone tools systematically and with a consistent pattern.

Paleontologists have thus classified it as belonging to *Homo,* the hominid genus to which modern man (*Homo sapiens*) belongs. One kind of early *Homo* is named *Homo habilis,* another is the extinct *Homo erectus,* and the third, the extant *Homo sapiens.*

With six possible species of hominids—three of *Australopithecus* and three of *Homo*—and with five of these six species extinct, which of them were our ancestors? A study of the anatomy may provide answers to this question, although it is essential to know the time periods in which each fossil group existed to gain a clearer picture of man's evolution.

Dating used to be matter of sheer guesswork. From the fossil animal bones found along with the hominids at a particular site like Sterkfontein, one could say that this site contained an older, or earlier, fauna than that of Kromdraai, another hominid site in South Africa. Scientists could not tell, however, how much earlier, although guesses were plentiful. Recently, new techniques have made more precise dating possible.

The first important conclusion is that hominid fossils date back at least five million years, although relics older than three million years are scanty and come from only two or three sites. South and East Africa, however, have provided substantial numbers of fossils that are three million years old or less. Any hypothesis about what happened earlier than three million years ago is bound to remain uncertain until more fossils are unearthed from these depths of time.

Although not all of the six species existed at the same time, for a very large part of the period between one and three million years ago, a gracile form and a robust form of hominid coexisted in Africa. If all the known early hominids are plotted according to species, area, and time, a pattern of populations emerges. From this pattern, a phylogeny, or family tree, of man takes shape.

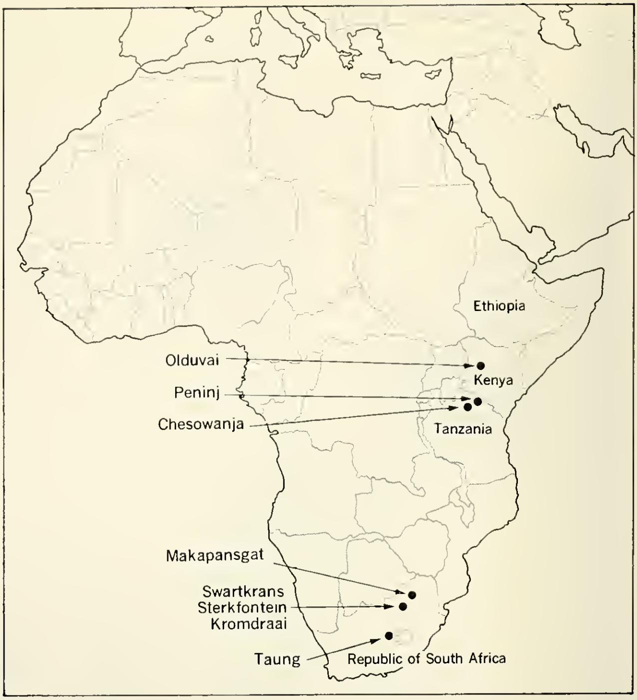
The tree's upper branches are more certain than its trunk, which various scientists have drawn with different lengths. Some suggest a relatively short trunk with its roots placed some five to eight million years ago. This view is supported by the evidence that the protein molecules and the DNA of man and the chimpanzee are astonishingly similar, suggesting that they diverged fairly recently. As we have few good hominid fossils from this period, the theory remains unconfirmed.

Others propose a longer hominid family tree trunk with roots that go further back in time. In this commonly held view, the gracile lineage was ancestral and can be traced back to some higher primates called *Ramapithecus*, which lived in India and Africa about twelve to fourteen million years ago in the Miocene epoch. Another view regards the robust lineage as ancestral and places its roots in a species of *Gigantopithecus*, which existed in China about twelve million years ago.

The missing links in the chain of evidence lie in the rock strata deposited between twelve million and three million years ago. The next crucial breakthrough in our understanding of hominid origins will certainly result from discoveries in those ancient layers of Miocene and Pliocene rocks.

In the branches of the hominid family tree, the evidence suggests that by three million years ago, the ancestral *Australopithecus* had given rise to the first members of *Homo*. Disproportionate enlargement and restructuring of the brain and the presence of the first stone tools mark the emergence of this wholly new and freakish trend in hominid evolution leading to man.

About the same time or soon after, the ancestral hominid gave rise to another line of development. An increasing dependence on larger and larger premolars and molars with accompanying hypertrophy of the jaws and the chewing muscles marked this species. In South Africa, this trend attained modest proportions in *Australopithecus robustus;* in East Africa it reached a crescendo in the aggrandized *Australopithecus boisei.* Both of these closely related robust lineages seem to have died out about one million years ago and apparently made no contribution to modern man. On the other hand, the early *Homo* of three to two million years ago subsequently carried the trend of cerebral increase still further, giving rise to *Homo erectus* between two and one million years ago. Between 500,000 and 100,000 years ago, *Homo erectus* gave way to *Homo sapiens.*



Australopithecus africanus, in this view, spawned two major offshoots—*Homo* and the robust lineages. Did the gracile australopithecine itself persist alongside these two sets of possible competitors? There is little or no trace of such persistence—except perhaps for the Taung child.

Until recently, there was little real information about the age of any of the South African australopithecine caves. None of the five sites in the Transvaal and Cape Province contained undisturbed materials suitable for radioisotope dating; however, the faunal remains discovered with the australopithecine remains at each site could indicate the relative ages—the oldest and the youngest—of the hominid fossils. In East Africa, paleontologists have correlated the faunal remains with potassium-argon dates enabling them to describe the kinds of pigs and elephants living at each stage during the past five million years. By comparing fossils of similar species found in South African sites with those of East Africa, they have been able to infer that the fauna of Makapansgat and Sterkfontein in the Transvaal corresponded to that living in Kenya two and a half to three million years ago. Similarly, the fauna accompanying the Swartkrans australopithecines matches the East African fauna of about two million years ago. Such comparisons have not yet proved possible for Taung because the fauna there, save for baboons, is relatively sparse.

For many years paleontologists regarded Taung as the oldest of the five South African sites. Yet the evidence for this view was slender, based mainly on sketchy samples of small mammals. Lawrence Wells of Cape Town has questioned the traditional view for nearly a decade and has concluded from his studies of the Taung fauna that the Taung site is more recent than was believed. It could indeed be contemporary with the youngest of the other four South African sites. Until recently his view was overlooked by most paleontologists, who continued to regard Taung as the oldest South African australopithecine site.

Two new lines of evidence within the past year have strongly confirmed Wells's view. Timothy C. Partridge, a young South African geomorphologist, has attempted to determine the approximate date that the *Australopithecus*-bearing limestone caves opened to the exterior. By gradual extension of underground cavities in the limestone formations, hastened by roof collapses and erosion of the land surface, subterranean caves acquire an external opening. Only after this occurs can surface-derived materials, including animal bones and soil, fall to the bottom of the cave and begin the process of breccia formation.

Partridge has found that the Makapansgat cave opened 3.7 million years ago; Sterkfontein, 3.3 million; and Swartkrans, 2.6 million. Partridge's dates are all somewhat older than the dates placed on the fauna in the same sites.

That is precisely what one would expect. For it would have taken a considerable time *after* the caves opened for the breccia layers to accumulate to the level at which the pigs, elephants, and australopithecines were found. His dates, although stormily received by geologists, are therefore compatible with the faunal dates.

Taung provided Partridge with his greatest surprise; he found that the cave had opened within the past 900,000 years. This astonishingly recent date confirms Wells's claims that the Taung fauna points to a much younger age than was formerly believed.

In another recent study, Karl Butzer of the University of Chicago has meticulously restudied the sequence of geologic events at Taung and, by comparing them with sequences elsewhere, has concluded that the Taung deposit may be younger than that of Swartkrans and Kromdraai.

If these claims prove correct and the date of the opening of the Taung cave is indeed more recent than 900,000 years ago, the age of the Taung australopithecine skull could well be less than 800,000 years. It may be only three-quarters of a million years old, for it came from a part of the Taung breccia appreciably higher than, and therefore younger than, the oldest breccia formed after the opening of the cave. This would make the Taung skull the latest surviving australopithecine in Africa.

In East Africa, the most recent australopithecine deposits are those of Peninj in northern Tanzania and Chesowanja in central Kenya. Both have been dated to just over one million years old. Both, incidentally, have yielded fossilized bones of robust australopithecines, evidence that the robust hominid lineage survived long after the gracile australopithecines gave way to *Homo*.

Does the recent age of Taung change its status? Most paleontologists have classified the gracile hominids of Sterkfontein and Makapansgat as belonging to the same species as Taung—*Australopithecus africanus*. Yet the new evidence of the recency of the Taung skull places two million years between it and the earlier gracile ape-men of Sterkfontein and Makapansgat.

There are several possibilities to explain this wide interval. While *Australopithecus africanus* was evolving into *Homo* in East Africa, a southerly branch of the species may have persisted in South Africa for another couple of million years as a relict population of living fossils. Or perhaps, by chance, the later hominid finds dated to the two-million-year interval just do not include any gracile australopithecines.

For a number of years I have questioned whether it is correct to assign the juvenile Taung and the gracile hominids of Makapansgat and Sterkfontein to the same species. The prepubertal status of Taung makes comparison with the adult and adolescent specimens of those other sites difficult. The only permanent teeth that can be compared are the upper and lower first molars, while there are not many milk teeth from either the gracile or the robust australopithecines that can be compared with the Taung teeth. So I worried about whether Taung was or was not the same kind of creature.

The young date of Taung has justified my worries. If a gap of two million years really exists between the Taung skull and the others and if they are in the same lineage, how are we to account for this lengthy survival of the species when all around were hominizing into *Homo* or specializing into *robustus?*

At the chronological level to which Taung has now been provisionally assigned, the only other hominids known are the last of the robust australopithecines and *Homo erectus.* Was Taung a third surviving hominid contemporary with these others, as our existing views maintain? I suggest rather that it could represent one or the other of the two well-known groups of hominids that were its contemporaries. Clearly, brain size and facial and dental morphology would rule out Taung's being *Homo erectus.* There remains the last of the robust hominids. The hypothesis that Taung represents a juvenile robust australopithecine would recognize what the fossil record suggests—the early extinction of the gracile australopithecines, not long after some of their populations had evolved into early *Homo.*

The suggestion that Taung may belong to the robust line is the subject of a new heated controversy, just as it was half a century ago. But argument, rhetoric, and vituperation will not solve the problem. Only a new and meticulous study of the Taung skull, in comparison with the other early hominid juveniles now available from both South and East Africa, will permit Dart's child of 1924 to show itself in its true colors.

These days, when I look at the Taung skull in my laboratory, I imagine I detect a slight Mona Lisa-like smile—or is it a smirk?—crossing its million-year-old, fifty-year-old, five-year-old face. The child of Taung must have chuckled in 1924 at the preconceived notions his frail bones had overthrown. Just so, in my mind's eye he laughs again in 1974, as big, grown men grapple anew with his mystifying identity.□

A Hominid Skull's Revealing Holes

by C. K. Brain

The valley was already in shadow when the band of ape-men crossed the grassy hillside to the shelter of the trees fringing the river. A young male lingered behind, unaware of the leopard crouched among the rocks of a nearby dolomite cliff. With a single leap the predator landed on the youth's back and sank its canines into his throat. After a brief struggle the leopard picked up its prey, dragged it to the base of a large *Celtis* tree growing beside the cliff, and carried the body up the vertical trunk into the branches above, where it started to feed.

What role has predation of this sort played in controlling populations of early hominids? As hunters and gatherers evolved in Africa, they formed a part of a natural predator–prey community: hunters in their own right, but also potential prey for the larger carnivores. The degree to which predation affected early human life can only be discovered by examining preserved remains; such remains are rare, but they do occur at a few sites. One is Swartkrans, an ancient cave within a mile of the Sterkfontein fossil site in the dolomite country of South Africa's Transvaal. Not only does the Swartkrans cave deposit contain abundant remains of *Australopithecus robustus*, together with bones of associated carnivores, but it has also yielded evidence that early men lived alongside the australopithecines.

In 1949, when it appeared that the fossil deposits at Sterkfontein had been exhausted, paleontologists Robert Broom and J. T. Robinson turned their attention to a new site, Swartkrans, a mile northwest of Sterkfontein. The new site interested them because they had seen fossil bones in exposed breccia on the hillside there. The first block of rock that Broom and Robinson excavated contained part of an australopithecine jaw. Subsequently, other blocks of the fossil-bearing rock, dislodged from the breccia by dynamite charges, revealed numerous australopithecine and other faunal remains.

Unfortunately, lime miners as well as paleontologists had their eye on Swartkrans. While the paleontological team was away over the Christmas holidays, a local miner moved in with his gang. So it was that Swartkrans became a lime mine during 1950 and 1951.

In 1965, the miners having long gone, I returned to the site to investigate what was left of the fossil-bearing rock. For seven years we worked through the miners' rubble, sorting out the rock and exploring the ramifications of the cave system. Gradually a picture emerged of how the cave evolved.

The formative process began several million years ago when the dolomite below the water table was dissolved, forming a cavern. With the passage of time the water level dropped and the subterranean cavern filled with air. Then a large block of dolomite, weighing many thousands of tons, fell from the roof into the cavern below, dividing up the space and creating what we have named the outer, inner, and lower caves. Percolating solutions deposited a substantial stalagmite over the fallen floor block, while stalactites encrusted the walls and roof.

About one and a half million years ago, erosion of the dolomite above the cavern produced a shaft linking the outer cave to the surface. Soil, rocks, debris, and bones of australopithecines and other animals washed through the shaft to build up the deposit, which when calcified by dripping solutions, formed the primary breccia of the outer cave. Over a period of a million years, water passing down the shaft and through other cracks in the roof of the cave severely eroded this mass.

A second shaft developed close to the outer cave's south wall half a million years ago. Through it came another deposit, known as the secondary breccia. It contained no australopithecines, but had traces of *Homo erectus* as well as comparatively modern faunal remains. This later sediment infiltrated the eroded surface of the primary breccia, creating a complicated stratigraphic situation. It also filled the inner cave.

During the last half million years, erosion of the dolomite hillside has removed the roof of the outer cave, exposing the two breccias on the surface. Water flowing to the lower cave has carved a series of irregular channels through both breccias, further complicating an already complex situation.

We only recently discovered that the outer cave contained two breccias of very different ages. For years we assumed that this cavern contained a single deposit and that all the fossils from it were of about the same age. But I was continually nagged by the problem that the australopithecine fossils were found in only one part of the outer cave. Breccia from close to the north wall of the cave invariably contained australopithecine remains, while similar material from elsewhere in the cavern, although rich in bone, had none. By studying the breccia faces, we concluded that there were two separate formations, probably of different ages, that had entered

C. K. BRAIN

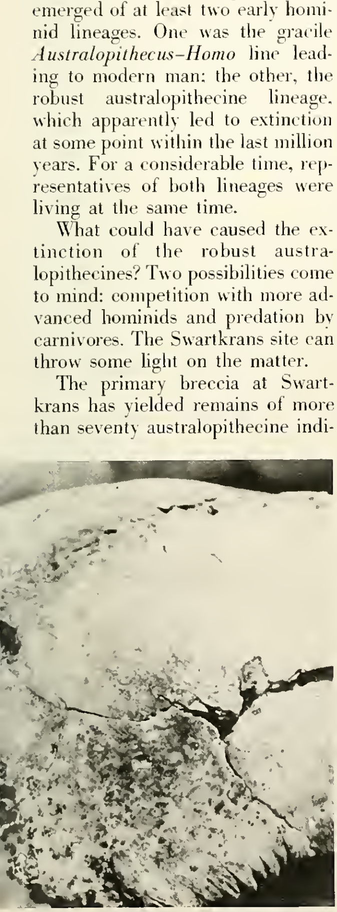
the cavern through different shafts.

I then separated the fossils on the basis of the type of breccia that enclosed them and was delighted to find an almost complete agreement between this division and that based on taxonomy alone. The fauna associated with the australopithecines proved to be an ancient one, including many extinct forms, while that from the secondary breccia had a decidedly modern aspect. By the time the second shaft opened at Swartkrans, the australopithecines had disappeared from the scene, although traces of true man, or *Homo*, are evident in both the older and younger breccias.

On the basis of South and East African evidence, a picture has emerged of at least two early hominid lineages. One was the gracile *Australopithecus–Homo* line leading to modern man; the other, the robust australopithecine lineage, which apparently led to extinction at some point within the last million years. For a considerable time, representatives of both lineages were living at the same time.

What could have caused the extinction of the robust australopithecines? Two possibilities come to mind: competition with more advanced hominids and predation by carnivores. The Swartkrans site can throw some light on the matter.

The primary breccia at Swartkrans has yielded remains of more than seventy australopithecine individuals ranging in age from infants to mature adults. Almost half the individuals were subadult when they died. Since the evidence is conclusive that *Homo* survived after the final disappearance of the australopithecines, it is quite probable that the advancing technology of *Homo* contributed to the extinction of any other hominids who may have competed for natural resources. But in addition to this possibility, Swartkrans provides evidence to suggest that predation by carnivores could have been an important factor.



Two fossils from the same deposit at the Swartkrans cave suggest that leopards preyed upon early man.

The australopithecine fossil remains at Swartkrans are preserved in a surprisingly small volume of deposit. We have never found complete skeletons, but the preserved remains show characteristic evidence of carnivore damage. Skeletal evidence of carnivores themselves is particularly abundant in the primary breccia. Parts of thirteen individual leopards, as well as remains of four species of hyena, have been recovered.

Where leopards and hyenas share the same territory, leopards must feed in places inaccessible to the scavengers if they are to retain their prey. In a woodland habitat, leopards have little difficulty in finding suitable trees for the storage of their prey, but in open country the situation is more difficult.

Swartkrans is situated in an area of undulating grasslands almost devoid of trees except along the watercourses. The cave's fossil fauna, dominated by gregarious plains-living species, suggests that open grassland conditions have prevailed over the last one and a half million years. Leopards hunting on the grasslands have to use cliffs, caves, and the few available trees to protect the prey they kill.

In this countryside, caves are typically of the shaft or sinkhole variety, with depressions surrounding their entrances. While the hillsides themselves are devoid of trees, the cave entrances characteristically support several large stinkwood (*Celtis*) or wild fig (*Ficus*) trees, which flourish in the depressions as a result of the protection afforded them from frost and fire. Leopards are attracted to the dolomite caves as places of safe retreat, while the nearby trees are valuable for the storage of their prey. The food remains of the leopards fall into the cave entrances, and some remains, missed by the waiting hyenas, work their way far below the surface. The Swartkrans primary breccia deposit accumulated over a period of perhaps 20,000 years, during which leopards probably used the cave and its trees on innumerable occasions as a feeding place and lair.

One of the australopithecine fossils from Swartkrans appears to bear direct evidence of leopard predation. The specimen consists of the incomplete brain case of a juvenile, thought to have been about twelve years old at death. In each parietal bone is a small hole, somewhat elongated laterally. The holes were evidently made by two pointed objects with tips slightly divergent. On the internal surface of the parietals, flakes of bone have been lifted, suggesting that the bone was fresh and pliable when the injury was inflicted.

A carnivore may have caused the damage; the spacing agrees best with that of the lower canines of a leopard. The upper canines would have fit into the eye sockets. Considering modern leopard feeding behavior, one is tempted to infer that the injury was not inflicted during the kill, but rather while the child was being dragged to the final feeding site.

The evidence of the Swartkrans cave suggests that the robust apemen, our slow-witted vegetarian relatives, were once common on the Transvaal grasslands. For some reason they disappeared, the hazards of life on the open savanna having become too much for them. Among those hazards, the leopard may have loomed large, causing many an australopithecine nightmare. □

ANDREW SKOLNICK

Dragonfly perching on stalk

A Special Light to Steer By

When polarized light waves shift from the overhead sky, many insects become inept fliers, sedentary ambushers, and midday lingerers

by William G. Wellington

When an insect flits from one plant to the next, it uses a number of directional cues. Gradients of temperature, moisture, and light; patterns of brightness and color; directional movements of air and odors—all can be used for guidance.

Most of those guides are worthless, however, when the same insect flies straight across a large open space. Neither temperature nor moisture gradients can be used to set a course across a broad lawn or a large clearing. Nor can the insect rely on wind or odors, both of which are useless for straight-line travel in the midst of an open area.

In such circumstances, visual cues become especially important. Bees and wasps, as is well known, can use landmarks in a familiar locality. But they, and many other kinds of insects, can also fly straight across featureless terrain where there are no landmarks. From time to time, therefore, scientists have suggested other visual mechanisms to account for that ability.

The most plausible—and certainly the most appealing—suggestion proposes that the insect is able to keep a straight course by continually adjusting its line of travel to hold the image of the sun steady on one part of its eye. In this "sun-compass" reaction, the insect supposedly uses the image of the sun much as we use the needle of a magnetic compass.

There is no doubt that insects use the sun as a reference point. But there is mounting evidence that they do so by using its heat, not its image. Since their ability to detect temperature differences across their heat receptors is adversely affected by air currents, their "heat compass" is often least effective where it could be most useful, that is, in the middle of an open space. In fact, the most effective method available to insects for setting courses across open areas is derived, not from their capacity to sense the sun's position, but from their ability to perceive polarized light.

As early as 1940, I. Verkhovskaya discovered that fruit flies could perceive polarized light. Unfortunately, her report in the Russian literature was overlooked in the wartime disruption of international scientific communication. Then in 1948 Karl von Frisch brilliantly demonstrated that honeybees, through their dances at the hive, used polarized sky light to communicate the direction of a food source. In the wave of enthusiasm that followed his demonstration, many other investigators soon found that several kinds of animals, including insects, not only perceived polarized light but also used it in directed movements.

Because the experimental method usually required observations of the animals' responses under polarizing filters, those initial studies had to be conducted with specimens that were prevented from flying. Consequently, except for honeybees, which could be observed arriving at, and departing from, a site, no flying insect was intensively studied in its natural setting and not even honeybees could be tested in free flight.

Before that gap could be filled, interest shifted from the behavioral consequences of polarized light perception to its physiological and structural bases. Since our own capacity to perceive polarized light is limited, the urge to discover how insects can see so clearly what we can only imagine is understandable. But hot pursuit of that physiological "how?" led to neglect of the behavioral "what then?" and thus to continued ignorance of the ecological consequences. No one knew, for example, whether an insect's ability to perceive polarized light affected aspects of its daily life other than travel. Indeed, no one asked. So some of our more unrealistic views about an insect's world remained intact longer than they should have. Before we look into that world from the insect's point of view, however, we should consider the phenomenon that has so effectively obscured our perception of it: the polarization of sky light.

A wave of sunlight approaching the atmosphere vibrates in virtually every plane at right angles to its direction of travel, that is, it is unpolarized. After entering the atmosphere, however, the wave may collide frequently with gas molecules or minute dust particles. During these collisions, some planes of vibration will be eliminated. Finally, the traveling wave may vibrate in only one plane; it has been plane polarized.

The percentage of polarized light varies in different parts of the sky. There is none immediately around the sun or at the point directly opposite. The greatest amount is always located midway between these two points, at a 90-degree angle to the line joining them. The geometry is most easily visualized near sunrise and sunset. At those times the solar and antisolar points are both close to their respective horizons, and the patch of most intense polarization in the sky is directly overhead, in the zenith. In contrast, at solar noon in the Northern Hemisphere, when the sun is in the south and at its highest daily altitude, the antisolar point is far below the northern horizon, and the area of maximal polarization has shifted northward out of the zenith.

Consequently, zenith polarization waxes and wanes daily, with its maximums near sunrise and sunset and its minimum at noon. Seasonal differences in solar altitude affect the amount of that minimum. In summer, the unpolarized, glaring aureole surrounding the high midday sun intrudes into the zenith, even in the higher latitudes of the Temperate Zones, thus reducing overhead polarization to zero. Varying amounts of polarized light occur in the zenith at noon during other seasons, at least when the sky is clear. A sufficiently dense, unbroken patch of cloud entering the zenith at any time of day immediately eliminates polarization there for the duration of its passage.

Thus, there are two events leading to minimal values of zenith polarization: one recurs daily near solar noon during summer; the other occurs irregularly, but still predictably, with the passage of sufficiently dense clouds during any season. Together they provide a route for discovering how perception of zenith polarization affects the lives of insects.

Although several hypotheses have been proposed, we do not know how insects "see" polarized light. We do know that whenever polarization is sufficiently intense for them to do so, they adopt and hold a heading by referring to the plane of polarization while they travel. Their reliance on the plane can be demonstrated by holding a polarizing sheet, such as Polaroid, over them as they travel on the ground. If the axis of the filter is aligned so that it transmits light in the plane the insects are using, they ignore its presence and maintain their original heading. But if the sheet is suddenly rotated 90 degrees to change the plane of the transmitted light, the insects will abruptly change their heading by the same amount, slavishly following the shift in plane. In contrast to that typical response in the presence of polarized light, insects traveling during times of little or no polarization neither follow straight courses nor respond to polarizers rotated over them. They are not using the sky as a guide.

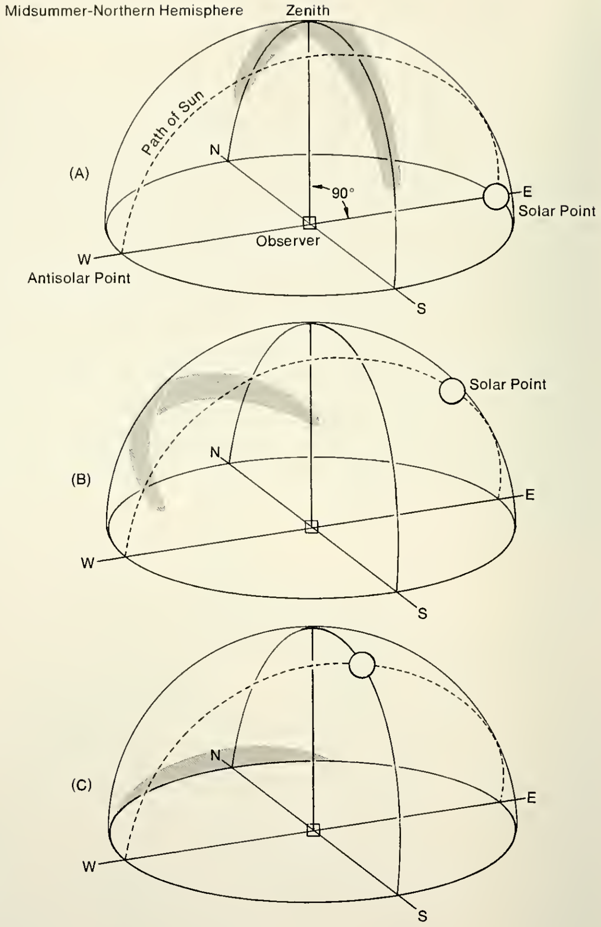
The presence or absence of a response by grounded insects travel-

Caught in unfamiliar territory by the noon sun or a cloud cover, a bee will rest on a flower until polarized light returns to the zenith.

ing under Polaroid can thus be used to detect changes in their capacity for long-distance, straight-line travel. We can compare their responses at solar noon or when the zenith is cloudy with their responses at other times of the day. Simultaneous observations of the behavior of similar insects flying free in the vicinity will soon show whether there are any changing patterns in their actions that can be associated with the movements of the grounded insects under Polaroid.

The observations can take several forms. We can compare pairs or groups of the same or different species. In some tractable species, the responses of one individual can be compared during an alternating sequence of ground and aerial tests whenever the state of the sky changes. Meanwhile, if during the series of comparative tests we record all the various kinds of naturally occurring activity and behavior among insects in the vicinity, a picture of the changing patterns of behavior at the site soon begins to emerge. And if some insects are marked and released so they can be identified during later encounters, the evidence they provide about the proportions of residents and transients in the locality completes the picture. Such observations can be made wherever industrial smog has not totally obscured the sky; most of those described here were made in my garden.

Some especially interesting differences between residents and transients appear when the summer sun eliminates polarization from the zenith. Dragonflies, which are noted for their effortless flight and hawking skill, provide a dramatic example. When there is no polarized light in the zenith, those skills are apparent only in places where the insects have established "beats" between familiar landmarks. Caught aloft by the noon sun's aureole while they are dispersing through unfamiliar territory, these masters of the air bumble earthward as ineptly as any novice pilot whose instruments have failed. If they land where there is no food, they perch quietly during the entire period that the aureole is near the zenith. But if there is a swarm of gnats poised



The amount of polarized light varies in different parts of the sky: the area of greatest intensity (dark gray patch) occurs midway between the solar and antisolar points. The amount of polarization decreases as the observer looks toward these points. At sunrise (A), when the sun is barely above the horizon, the area of maximum polarization is in the zenith, directly above the observer's head. At midmorning (B), as the sun rises higher in the sky, its antisolar point sinks, and the area of greatest polarization shifts below the zenith toward the northwestern part of the sky. By noon (C), the sun is nearly overhead and the area of greatest intensity has shifted to just above the northern horizon. Since insects respond primarily to zenith polarization, they cease traveling at midday in summer and substitute other activities.

H. PETER LOEWER

over a nearby bush, they will intermittently dart into it, catch one of the dancers, then return to the perch to eat it. Thus, when there is no polarized light overhead, they not only stop traveling through unfamiliar territory, they also change their hunting style from ceaseless roving to sedentary ambushing.

Dragonflies are not the only predators to change in this way. The black-and-white bald-faced hornet is normally a restless forager, ranging widely in quest of prey. But caught far from its nest by the midday change in the sky or by sudden cloudiness, it too perches like the dragonfly.

A rhododendron bush in my garden—where numerous small flies, as well as hornets, rest through the summer noon—provides the setting for a deadly game, one whose rules change with the air temperature. If the noon air temperature is below 60 degrees Fahrenheit, all the insects bask quietly in the sun, seldom moving unless startled. Even then, they do not fly straight off across the open spaces of adjacent lawn—that type of flight requires a sky compass—instead, they merely flit to a nearby leaf.

On a cool day, the flies rest close to the middle of the rhododendron leaves, where radiant heat from the sunlit surface warms them by as much as 10 degrees above the air temperature. A fly resting in the middle of a long rhododendron leaf is not likely to be startled by shadows moving on the outer edge. Consequently, since the fly rarely moves, the hornets rarely notice it.

If the air temperature is between 75 and 80 degrees, however, the middle of a rhododendron leaf may become too hot for flies and hornets alike. Both then perch close to the tip, where the leaf temperature is only 1 to 3 degrees higher than the air temperature. In that position, the flies, more often startled by shadows, repeatedly flit from leaf to leaf. The hornets pounce from ambush on any flies that land near them.

Mosquitoes that frequent alpine regions by day also exhibit a comparable change in feeding behavior during midday or under zenith clouds. During such periods, they stop their long, roving flights, resting instead on vegetation and rising only when disturbed (or attracted) by something moving nearby.

Not all predators become sedentary when their sky compasses fail. Ladybird beetles and several kinds of small parasitic wasps habitually search places where there may be potential hosts, moving on if they find none. When there is polarized light overhead they alternately search and travel, but when there is none, they cease traveling and confine themselves to one place, repeatedly searching the plants until the sky changes and they can again travel.

These beetles and wasps are frequently used in the biological control of pests, and one wonders whether some releases have failed because the insects were liberated at the wrong time of day. If the weather is clear, releasing such insects under a high sun would insure some local searching before the inevitable dispersal takes place. But releases early or late in the day, when there is more polarized light overhead, would increase the chances of rapid dispersal, perhaps beyond the area where the concentrations of pests would have helped the predators establish themselves.

An insect's residence in a locality no doubt confers advantages. When other guides are lacking, familiar landmarks enable insects to move from plant to plant through their home range. While wasps and bees have always been considered superior in this ability, during this study I saw that other kinds of insects also have a remarkably good memory for landmarks, as well as a well-developed "sense of place," which they most often demonstrate near midday.

Some insects, for example, make extensive rounds each morning and afternoon, but return to one special place on their route each midday, at about the time the aureole of unpolarized light is beginning to invade the zenith. Some muscid flies and some butterflies, such as the painted lady, merely bask after they arrive, occasionally flitting briefly among the plants. Others, like the cabbage butterfly, may not actually stop their rounds at midday, but instead modify their flight path to avoid crossing open spaces such as lawns, which they had crossed and recrossed all morning. Rather than continuing to fly across such openings at midday, they negotiate them by fluttering slowly around the edges, tracing right-angled paths where they earlier made a diagonal. A few species, such as the drone fly and the Lorquin's admiral butterfly, even return each day from their morning rounds to a particular station in the locality they favor. There they perch or hover, darting toward any landmarking bee that comes foraging at noon.

In these territorial species, members of the midsummer generation may, in fact, behave aggressively toward almost any moving object. It is a startling experience to realize that the gaily colored insect that has been tapping at one's hat, spectacles, and camera as it circles persistently is not sociable but hostile. How should one respond to an infuriated butterfly?

During a three-week period last July, one Lorquin's admiral was exceptionally punctual according to the solar clock, arriving in my garden each morning within 2 to 3 minutes of the time the aureole began to invade the zenith. It entered the garden from the west, perched on the rhododendron, and vigorously responded to the silhouettes of passing bush tits and robins briefly limned against the sky, as well as to any bees or cabbage butterflies that were active at noon. It defended the same 15 by 15 foot space during each midday period, leaving the garden again in midafternoon. Finally, old and tattered, it was displaced by a younger admiral that arrived at the same time one day and drove it from the garden.

Well before solar noon on summer days, the drone flies and their relatives the bulb flies establish small territories, often no larger than 2 by 3 feet and rarely bigger than 4 by 8 feet. Within these boundaries, the flies dart aggressively toward anything that moves. Every arriving or departing bee is harassed and butted. Bumblebees tend to ignore the onslaughts and are rarely knocked off balance unless they are struck while leaving a flower. Honeybees on occasion may be driven from the site, but some of the smaller bees, leaf-cutting bees, for example, may be effectively barred from pollen collecting in the locality.

Although drone flies occasionally feed from the flowers in their territory, the bulb flies almost never do. Nevertheless, the latter's proprietary behavior, more often than the drone flies', seems to prevent other insects from pollinating the briefly flowering plants near their stations.

During the late spring and early summer some of these flies may occasionally behave aggressively when there is polarized light overhead, as well as when there is none, but the most general, persistent, and violent displays take place when the aureole is in the zenith at midday or when there is an overhead cloud cover. Perhaps the increased aggression in the absence of polarized light is linked with the behavioral change that occurs then: the flies remain constantly alert within their small territories, instead of occasionally flying away to other parts of the garden for lengthy sessions of preening or feeding.

The spring and summer generations of all kinds of daytime fliers are most regularly affected by the midday minimum in polarization. Wasps, when they are far from their nests, cannot home then without a sky compass. Foraging bees are equally affected. If they have not learned the landmarks on their homeward route, they are confined to the collecting site until overhead polarization returns. Bees homing by polarized light are easily distinguished from those using landmarks. When the insects use landmarks, they fly low, zigzagging homeward from one route marker to the next. When they steer by the sky, however, they spiral upward briefly after taking off, suddenly adopt the appropriate heading, then maintain it by flying over, instead of around, trees, houses, and other obstacles.

As the summer advances, the aureole of the declining sun intrudes less and less upon the zenith and ultimately does not come near it. Thereafter, overhead polarization, although reduced, is not eliminated at midday, and the insects behave differently from their early summer forebears. In late summer or early autumn, the middle of the lawn at midday is no longer the quiet place it was earlier in the summer. Rather, there is as much din from rapidly passing insects at midday as at other times, and open spaces are no longer the noon preserve of local bees that know the landmarks.

When there is more travel during the middle of the day, there is no overt territoriality among butterflies or flies. The late summer generation of the drone fly is not aggressive. The flies continue their rounds through midday, feeding peaceably alongside other insects.

Clouds interrupt zenith polarization whenever they drift by in any season, and travel stops whenever they do. During the autumn, however, cool air temperatures prompt insects interrupted in flight by zenith clouds to bask in any available sunlight, just as they did on cool days earlier in the year. So periods of zenith cloudiness in cool weather may be periods of comparative quiet, when no insects fly. In contrast, insects that stop traveling on a warm day often continue to flit and buzz about one small area, thus producing a localized sound out of all proportion to their size or number. On a very hot day, that constant buzzing—made perhaps by only one nearby insect—sometimes leads us to believe that there is a great flurry of activity. This may be so, but more often the increased sound merely indicates that an insect has been forced to stay where it is too hot to sit.

I have repeatedly emphasized overhead polarization, ignoring polarization from other parts of the sky and also ignoring the solar image that insects supposedly use in sun-compass reactions. In so doing, I have followed the example of the insects I have watched, for they ignored the sun when they flew across open spaces. In the morning and afternoon they would continue to make long, straight flights as long as the zenith was clear, whether or not the sun was visible. But as soon as a cloud covered the zenith, even though the disk of the sun remained completely visible and even when it was not very high, they merely sat or flitted. If ever they could have used a sun compass, those were the times when they should have done so. Since they did not, I believe that they could not.

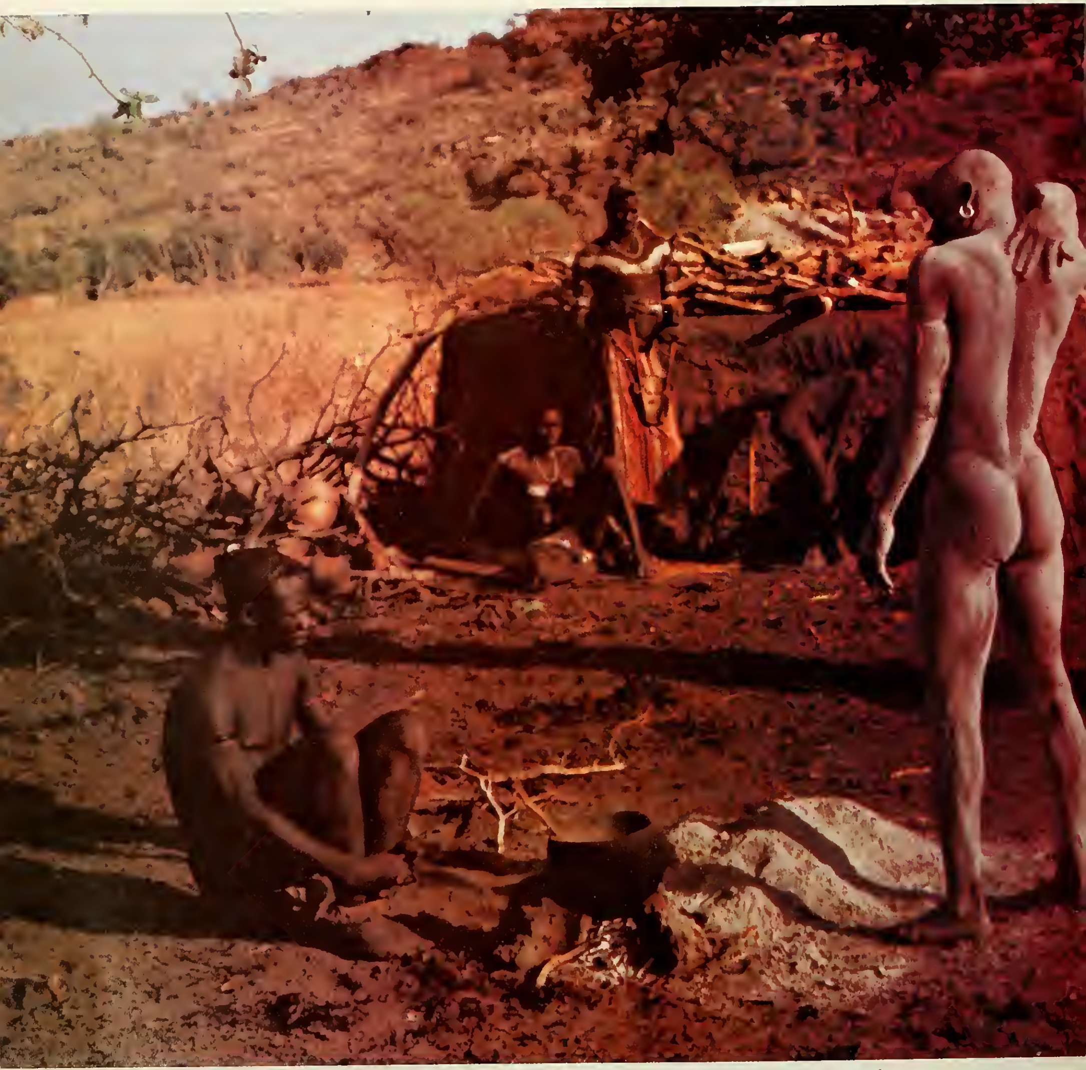
Furthermore, although it seems reasonable to expect animals with such large compound eyes to be able to use polarized light from parts of the sky other than the zenith, neither crawling nor flying insects seem to do so. In several experiments I have tried to induce crawling insects to respond to polarized light from parts of the sky other than the zenith, but they reacted to rotating Polaroid aimed toward those other parts only when their crawling surface was tilted so that the light from the new direction was "overhead."

Insects in free flight also behave as though the only visible sky were directly overhead. So whether or not their multifaceted eyes record events at a distance from the zenith, the insects' behavior shows clearly that they do not use information concerning polarized light from the lower reaches of the sky. Their important navigational aid is directly overhead.

Watching insects when they cannot travel gives a glimpse into a world where survival may be determined by an individual's position on a leaf, and where territories that are abandoned each afternoon are reoccupied and fiercely defended again the following noon. With a little patience, it is not difficult to observe these occurrences. But while doing so, we must struggle to imagine the processes whereby an inhabitant of that "polarized" world varies its territorial urge or changes its predatory style in response to visual signals that we can scarcely detect, let alone decipher. □

If there is no overhead polarization, a ladybird beetle will repeatedly search a small area for prey, such as aphids, right, then move on when the sky changes.

ANDREW SKOLNICK



Wrestling competitions are the focus of a young man's life. Wrestlers live apart from women in a secluded camp, or zariba. *This wrestler rubs his body with a white ash that confers mystical strength.*

A Vision of Primal Man

The Last of the Nuba, by Leni Riefenstahl. *Harper & Row, $18.95; 208 pp., illus.*

The last of the Mesakin Nuba, as the subject for a book and a proposed film, have preoccupied Leni Riefenstahl since 1962. She undertook to explore in a remote area of Kordofan Province, in the Sudan, certain extreme aspects of the human condition that reinforce and advance the artistic themes of her pioneer film days: man against the elements, athletes in the pride and discipline of competition, grace and dignity in tradition, and the beauty of the human form—all these give her life's work a romantic and peculiarly accurate character—obsessive and yet poetic.

Now, after many years of trouble and silence, the first important woman film maker of all time returns to us with powers undiminished by the passage of time. Leni Riefenstahl rose to flamboyant fame in a male-dominated field in a German society notoriously hostile to female careerism; she starred America's Jesse Owens as the hero of the first great sports film, *Olympia* (1938); she resisted Goebbels and his propaganda ministry's determination to stunt her livelihood and independence; and, for succeeding to document the hypnotic and massive Nuremburg rallies, she was victimized by gossip and sentenced to prison term after prison term in the wake of postwar righteousness and paranoia.

Although the wastelands of Kordofan are far from the Fatherland, they became a natural stepping-stone, a consistent theater for her artistry, a last heroic refuge. The book, in a sense, is her final judgment. It demonstrates the astonishing Riefenstahl energy to fulfill a goal, the sensitivity to record a vision, the courage to endure. Her moving documentation of the Nuba helps to confirm the integrity of a life's work that evolved from esthetic, rather than political, sensibility and demonstrates how savagely she was judged. *Triumph of the Will* (1934), her Nuremburg documentary, which won gold medallions and first prizes in the France of 1937, sent her into a detention camp as soon as the war was over. The guilt of a generation was projected onto her threatening art, which had revealed the cruel enticement of Hitler's violent and decadent Nazi propaganda. Today her accomplishments rise above these many troubles—above the politics, the placard wavers, the linear thinkers who learned how to read and never could see.

A certain extreme image of man sent Leni Riefenstahl to the Nuba mountains. One of the truly exotic actresses of her day, she searched for some masculine equal to her own enormous sensuality and feeling for beauty. From the world champion skiers who acted as her assistants to the "Greek" torchbearer (a Pole whose life she took over to insure the perfection of the opening sequences of *Olympia*) to the *zariba* dwellers, the huge, ash-

by Peter Beard

covered wrestlers whose makeup "confers mystical strength and holiness"—she picks her favorites—hers is a world where the winner is remembered. Her view is of the best, perhaps the elite. It is not a fashionable view; it is a view in which those who cannot measure up are left outside to protest, wondering at the unfairness of a very separate world too involved with esthetics to be slowed down by ethics.

Compromises were never part of Leni Riefenstahl's vision. She knew Walt Disney well and rose above his popular anthropomorphism with the contempt of experience. Beauty demands *truth* and her outlook was never marred by the cheapening demands of popularity. The artist who can still see searches out the authentic. East Africa was too compromised for a Riefenstahl documentary, and she was only able to film for a few years in the Sudan (until 1964) before the galloping rot of modern society set in there. Age-old traditions were outlawed by missionaries who brought in green pants and rosaries. Money, roads, and paraphernalia corrupted the land.

The Last of the Nuba records a final glimpse of the genuine natural world that once surrounded and protected our own roots. Significantly it is not a world without subtlety, high art, and deep human feeling.

In a dry and humorless text (Riefenstahl's Achilles' heel), accurate details help us experience the ancient Mesakin and Korongo traditions of strength and gentleness, lyrical music, and powerful emotion.

The *zariba* wrestlers, under the winds and the stars, with a small fire and a stone pillow, are described for us by the only white woman to have gained access to their holy and ancient campsites. The author deeply appreciates the Nuba, who produce everything they need for survival and therefore enjoy a fundamental independence. They love music and art, they rank women almost as equal as men, they don't seem to associate nakedness with guilt, and look upon death as a matter of fate. Schools and other institutions hurry to save these "savages" and spread the misery around.

Leni Riefenstahl, 1944

The story of a German film lab destroying much of the early Nuba footage is too painful to go into—but typically the creator is undaunted. She raises money and returns to the Sudan where the age-old magic has been sadly altered. Her documentary is virtually over. Thousands of years of Mesakin Quissayr tradition have come to an end. The rush of modern times has crushed things in its way and left a mediocre hash of confusion. Now the Riefenstahl film will rely to a large degree on animating the stills shown in this book.

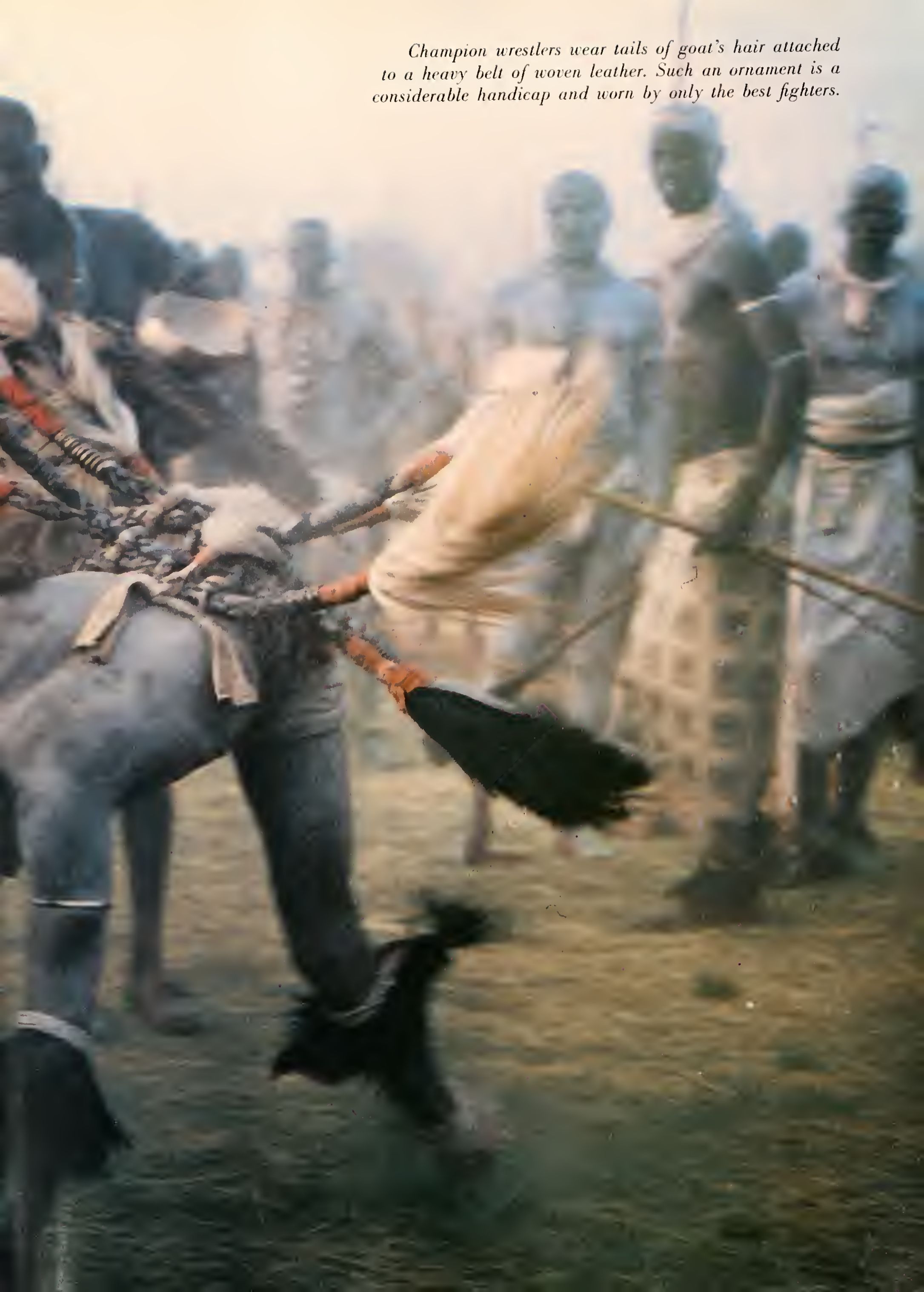
Magazine layouts imposed upon the author by English and then German publishers do not help the impact of the book, but the strength of individual photographs wins us. Near the end we attend the funeral of Napi, one of the Tadoro wrestling champions.

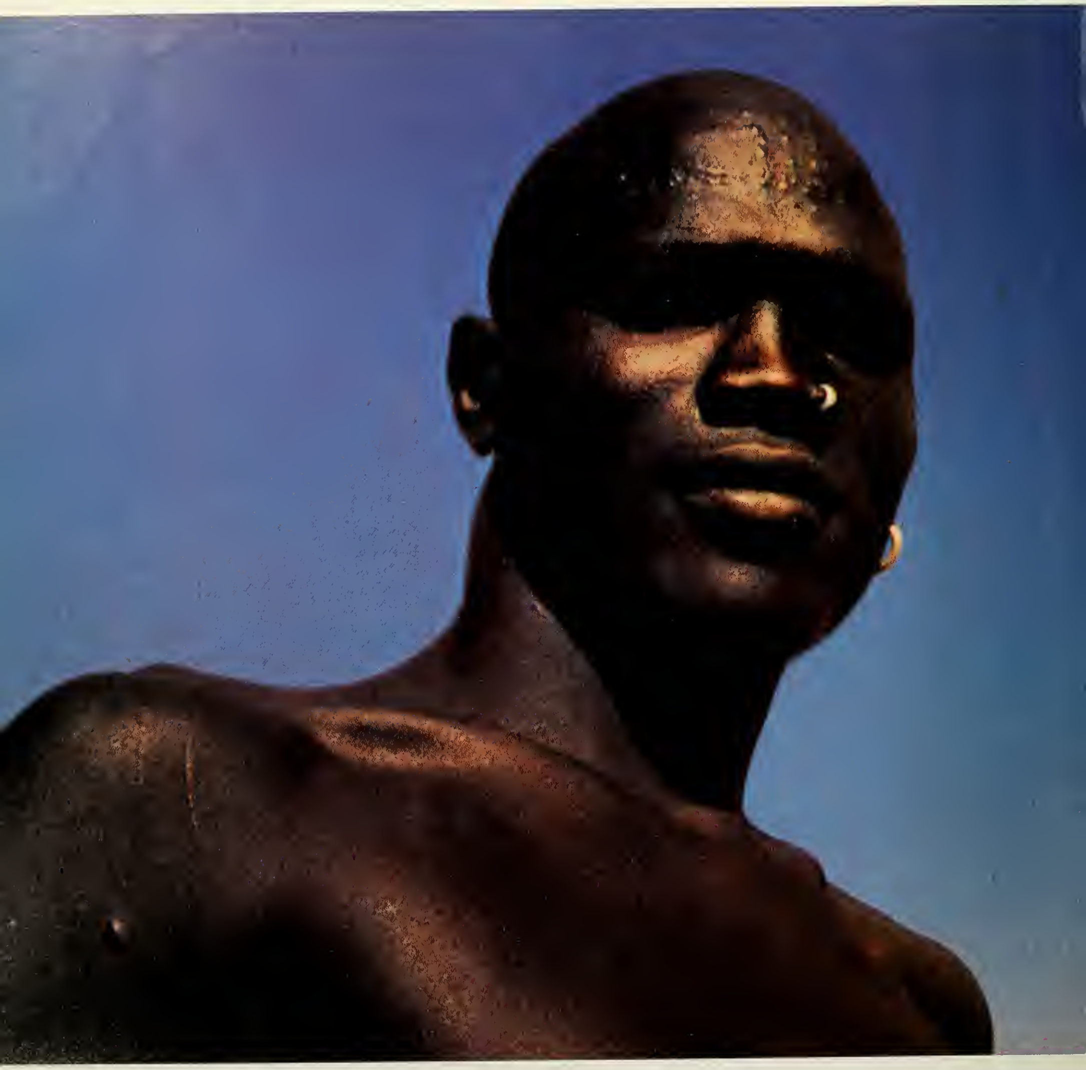
We see a bit of the dark corpse laid out under a white sheet. Napi's grandmother squats beside him, plastered in ash, staring into space with eyes more deeply sad than any we have seen. The champion's seed rattles hang from her fingers. A sister slips in the warrior's favorite knife. His mother takes beeswax and significantly blocks off his ears, nose, and mouth. The expressions at the burial are of people doubtful that so much that has just been lost can ever be replaced.

Peter Beard, photographer and writer, is the author of The End of the Game *and* Eyelids of Morning: The Mingled Destinies of Crocodiles and Men. *A new book on Africa,* Longing for Darkness, *will be published in the spring.*

Although the basic reason for wearing ash is religious, personal distinction is sought in the decorative patterns painted on the body with a mixture of ash and milk beaten into a cream.

Champion wrestlers wear tails of goat's hair attached to a heavy belt of woven leather. Such an ornament is a considerable handicap and worn by only the best fighters.





This Nuba wrestler, a champion of his village, will help train younger men. The raised marks on his forehead are a form of body decoration favored by both men and women.

. . . the Nuba

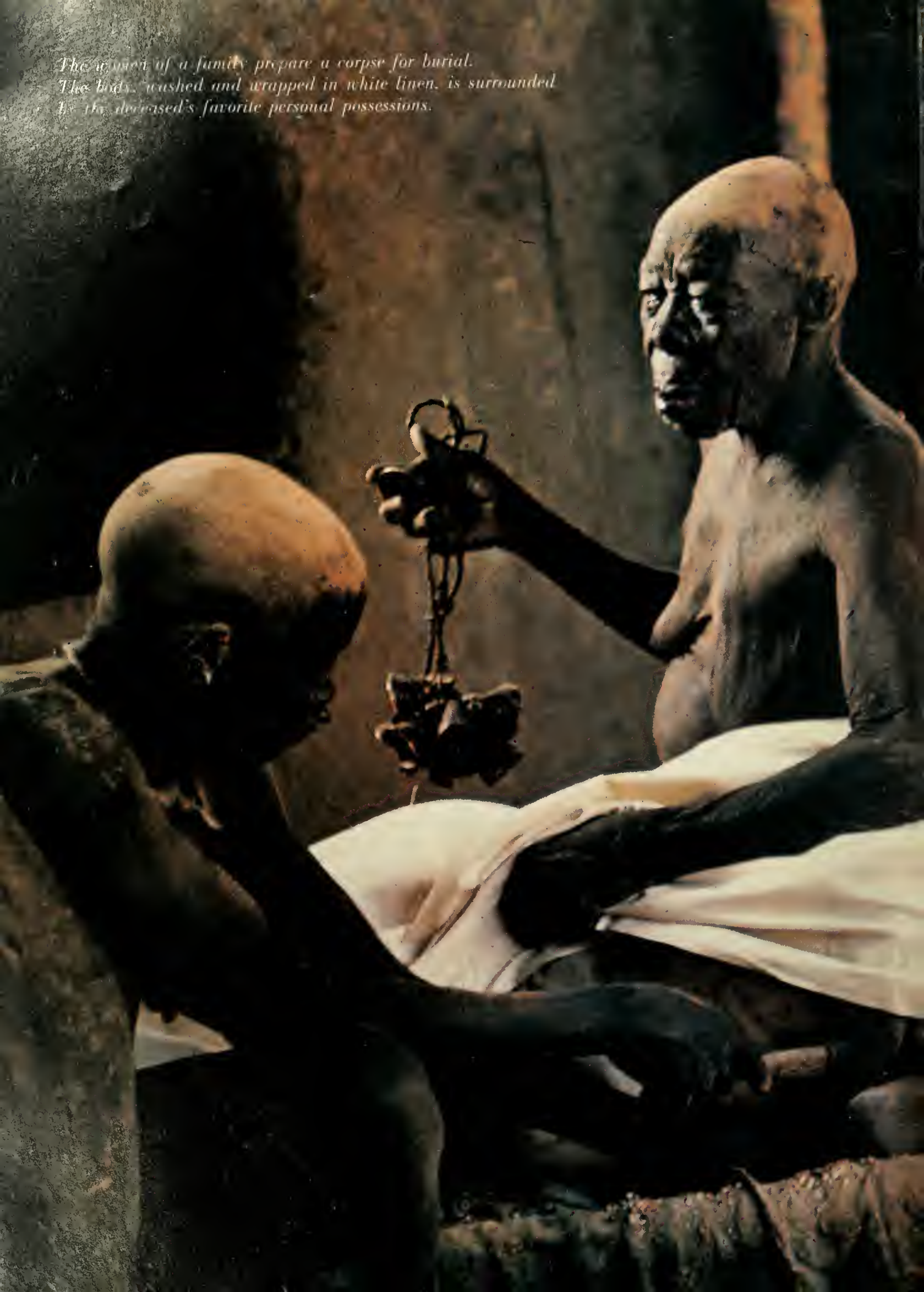
The Mesakin Quissayr, a Nuba tribe which, like the Korongo Nuba, has been very little exposed to the influence of civilization, live in the valleys and hills of the southwestern corner of Nuba mountains in Kordofan of the Sudan. The photographs in this book were largely taken among the Mesakin, and only few among the Korongo. They were taken between 1962 and 1969.

Their houses, resembling miniature castles, are scattered over hills that rise several hundred feet above the plain. The tallest reach 3,330 feet above sea level, with valleys running between them. By traveling thirty or thirty-five miles from Kadugli via El Hambra southward past the Moro mountains, one reaches Reikha (in the Arabic), or Tolabe (as the Mesakin call it). The village is on the plain but this is where the hills of the Mesakin begin, and here lives the *Mak*, the chief of the Mesakin of Tadoro. Tadoro is the hill community of Tolabe; and it is here that I settled, choosing it as point of departure for my excursions through the entire Mesakin area.

An estimated 8,000 Mesakin Nuba still live in the fifteen to twenty various hill communities. Each larger community has its own *Mak* (chief) and its *Kudjur* (doctor and priest). The Mesakin Quissayr's neighbors are the Mesakin Tiwal. In Arabic *tiwal* means high or long; *quissayr* means short, and Mesakin, derived from the Arabic *miskin*, poor. The Mesakin are the poorest of the Nuba; but in spite of their poverty they are a happy people.

To the south live the Korongo Nuba. Because water is more plentiful in Korongo, they have more cattle and are consequently better off. They are unusually tall and strong: often a whole head taller than the Mesakin. This may be partly attributable to the fact that the Korongo, above all the men, have far more milk and *dura* (sorghum), the chief diet of the Nuba. Yet the Mesakin are opponents to be watched during the traditional wrestling ceremonies since their great agility makes up for the greater strength of the Korongo. The Korongo and Mesakin cannot understand each other's language although they are such close neighbors. It is a remarkable fact that the two languages should be so profoundly different, even though these two neighbors share a common culture and are of similar origins. There are over 100 languages among the Nuba. Soon the inevitable march of civilization will reach the Nuba and change them. . . . I was fortunate to get to know them whilst their traditional way of life still existed, and to be able to fix this in pictures, films and recordings. It was a view into a paradise that will soon vanish.

FROM THE BOOK "THE LAST OF THE NUBA" COPYRIGHT © LENI RIEFENSTAHL, 1973 REPRINTED BY PERMISSION OF HARPER & ROW, PUBLISHERS, INC.



The women of a family prepare a corpse for burial. The body, washed and wrapped in white linen, is surrounded by the deceased's favorite personal possessions.

NATURAL HISTORY FILE

only $4.95 each

Holds a year's subscription - keeps all copies neat, clean and in one place.

A deluxe Royal Blue magazine case with "Natural History" gold stamped on the face. Has the expensive good looks of a leather-bound book. Organizes your valuable collection by year of issue. Reduces clutter in your home or office, keeps copies handy for easy reference. Sturdy bookbinder's board protects copies against soil and damage for as long as you want to keep them. Gold leaf furnished free for dating, etc. Send check or money order. Money refunded if not satisfied.

Natural History File . . . . $4.95 ea.; 3 for $11.95 postpaid

We have custom designed files for over 8,000 magazines. Order by title, $4.95 ea. ppd.

SHANNON CORPORATION Dept. 124N
734 N. Decatur Ave., Minneapolis, MN. 55427

A Guide to Ancient Maya Ruins

C. Bruce Hunter's guide to the ancient Maya civilization, profusely illustrated, including color photos and maps. What to see and how to go about it. $9.95 cl/$4.95 pa.

A GUIDE TO AMERICA'S INDIANS: Ceremonies, Reservations, Museums, by Arnold Marquis. Profusely illustrated. $9.95 cl/$4.95 pa.

MAYA CITIES, by George F. Andrews. More than 300 photos and drawings of Maya structures. $20.00.

ON THE TRAIL OF THE ARAWAKS, by Fred Olsen. The first account of the Arawaks, whose civilization matched that of the Maya. Profusely illustrated. $8.95.

INDIAN HERITAGE, INDIAN PRIDE, by Jimalee Burton (Ho-chee-nee, Cherokee). One woman's personal view, in words and pictures, of what it all means. 50 color plates. $12.50.

University of Oklahoma Press
1005 Asp, Norman, OK 73069

Ideal for Gift Giving . . .
1975 NATURAL HISTORY CALENDAR

Portraying Indians of the Great Southwest

Published by The American Museum of Natural History

Special Retail Edition

Only Natural History could bring you a calendar so beautiful . . . a tasteful gift to be valued even beyond the calendar year. Opening to full 12″× 18″, the calendar contains a splendid portfolio of 9″× 12″ color illustrations, each one worthy of framing, that depict American Indian culture and the scenic beauty of the Southwest.

$2 for one calendar, additional calendars $1.50 each. Third-class postage is included. For first-class mail delivery, add 50¢ for each calendar.

Send order with check to
Natural History Calendar Box 5123 Des Moines, Iowa 50306.

The Taste Makers

Our perceptual life would be vastly different without the tiny buds that line our tongue

Spread throughout the oral cavity of the average human being, on his larynx and pharynx and especially on the top and sides of his tongue, are some 9,000 taste buds. That, at least, is the approved scientific figure, which I will take on faith, even though I find it difficult to believe that a sedulous anatomist actually once devoted the time and patience necessary to do an accurate count of the taste buds in enough open mouths to justify the confident publication of a numerical result.

Yet, assuming he did, there we have it: a human universal as crucial to the perceptual life as having two eyes. Just as history would have been different if we had all been endowed with a third eye in the back of our heads, so too the world would not be the same if our tasting apparatus were significantly cruder (imagine a single cell on the ball of the right foot) or more sophisticated (for instance, if all the skin cells were as sensitive to all chemical traces as the receptors in the nose, which can detect the specific odor of vanillin at a concentration of 0.0000002 milligram per cubic centimeter of air).

The equipment for taste and smell that we do possess is an exquisitely discriminating instrument as it is. Indeed, it can sort out thousands upon thousands of tastes and odors so complex that scientists are only beginning to be able to analyze them. As of now, however, the

by Raymond Sokolov

tongue of a Proust is still the best apparatus for identifying the true taste of a madeleine; the nose of a winetaster, the most sensitive available gauge of wine quality.

Still, no matter how accurate the judgments of our senses of smell and taste may be, we are properly uncomfortable in accepting them as we would the reports of true scientific instruments because such evidence is notably subjective and not easily quantified. Worse yet, the vocabulary available to describe food tastes in ordinary language is sparse, vague, and misleading. Gastronomic writers fall back on such terms as "succulent," "unctuous," and "pungent," not out of a passion for luscious verbiage (not entirely at least), but because they have little else at hand once they have exhausted the four basic terms: sour, salty, sweet, and bitter.

A similar problem of verbal classification used to exist with colors. In the ancient world, color words were not specific; they referred to tones. "Sallow" is a surviving example of this kind of inexact attempt to indicate color. Homer's "wine-dark sea" is another. Over a period of time, the concept of specific colors—reds, yellows, and blues—developed. Modern optics, the dye industry, philately, and the fashion press have recently pigeonholed such previously evanescent terms as vermilion, ocher, and even Connaught green so that we can say just which wavelength of visible light will produce them. Or, conversely, we have decided what names to give what wavelengths. In the taste field, for better or worse, we must still muddle along—just as we always have—without an accurate verbal system to classify our multifarious reactions to cinnamon and porridge and gin.

This lack of specific taste words seems to be a characteristic of all human languages. Prescientific peoples arrived at several different systems of taste naming. The Baganda tribe of Uganda divide all tastes into either *kuwoma* or *kowa*, "pleasant (sweet or salty)" and "unpleasant." This is a so-called hedonic system, which uses pleasure as its sole criterion. Islanders on Malekula in the New Hebrides also have found it sufficient to call good tastes *garak har*, bad tastes *kokon*, and leave it at that.

Not all systems of taste and smell classification are so simple. In the Totonac language of eastern Mexico, eight distinct word stems categorize the world of smell into eight parts. This sophisticated olfactory zodiac runs from good/vegetative to bad (human excrement, a drunkard's breath) to medicinal/aromatic (alcohol, urine, citrus skins) to body/animal (mice, feet, grease, dirty dishes) to sour (vinegar, sweat) to smells that leave a taste in the mouth (cooking odors, gunpowder) to artificial (perfume or soap that is pleasant but unsuitable to the user, who is often a perfumed man or an overperfumed woman) to smells that permeate the air, that is, wind-borne smells.

This system with its overlapping categories does not point the way toward a universal or correct taxonomy of taste and smell; nor, indeed, do those larger classifying systems of taste, which we call cuisines. Cuisines are a culture's full lexicon of its preferred taste combinations, but they are, to a crucial degree, arbitrary and the result of cultural inclination rather than a set of any orderly principles of taste.

To be sure, geography and history have played a part in the formation of cuisines. Aleut cooks have never experimented with the peach, and the Turks brought strudel to Hungary. But we do not define cuisines on the basis of one peripheral ingredient or one special technique. Rather we look to the methods and staple items that pervade meal after meal.

And when we do this, we discover that cuisines, like languages and kinship systems, are complex

BOB CAMPBELL

We'll die ..!

Survival of the fittest and fleetest on E.Africa's plains is hard enough, without poachers, their snares and fires added to our battle. They, and those who sent them, are after our skins, hides, furs, claws, hooves, horns and teeth. But believe me, we need them more than they. However if we don't get help soon,we'll go the same way as the Dodo. To extinction.

You are our hope and our help, and the link between us is the EAST AFRICAN WILD LIFE SOCIETY, East Africa's own conservation group, and the first of its kind in the tri-nation area of Kenya, Uganda and Tanzania.

It is non-profit, non-governmental, a body that has funded a list of conservation projects since 1961, as long as your arm. Every cent of your membership (US $11.00) goes directly to game conservation projects; and not one cent to "overheads".

THE *WILDLIFE* GETS ALL THAT YOU GIVE

As a member of the Society you will also receive a year's subscription to AFRICANA the quarterly wildlife magazine. And for those who are interested in gifts of every description which have to do with the game of East Africa, a 32 page colour brochure is available for US$ 1.00. They are also on sale from our gift shop and gallery in the Nairobi Hilton Hotel.

And while you're reading this, remember, that the Society is working round the clock on our behalf, in the field of education, anti poaching, research and animal rescue.

USA Representative:
Miss Alice Smith Box 1325, Chicago Ill. 60690

EAST AFRICAN WILD LIFE SOCIETY
Box 20110 Nairobi Kenya.

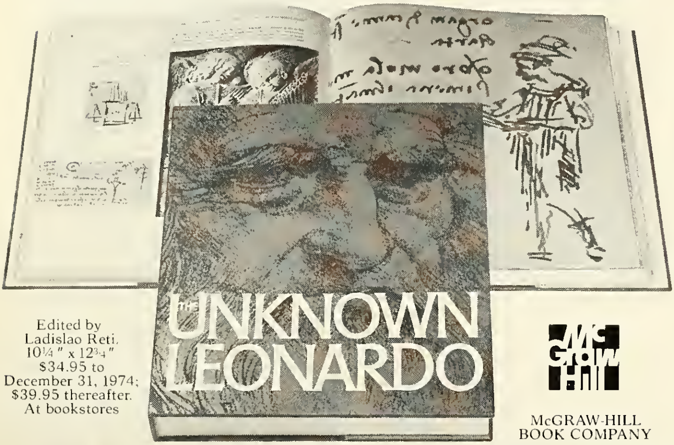
Please enrol me as a member.
I enclose US.$11.00 for my year's membership.

Name ____________________

Address. ____________________
____
____

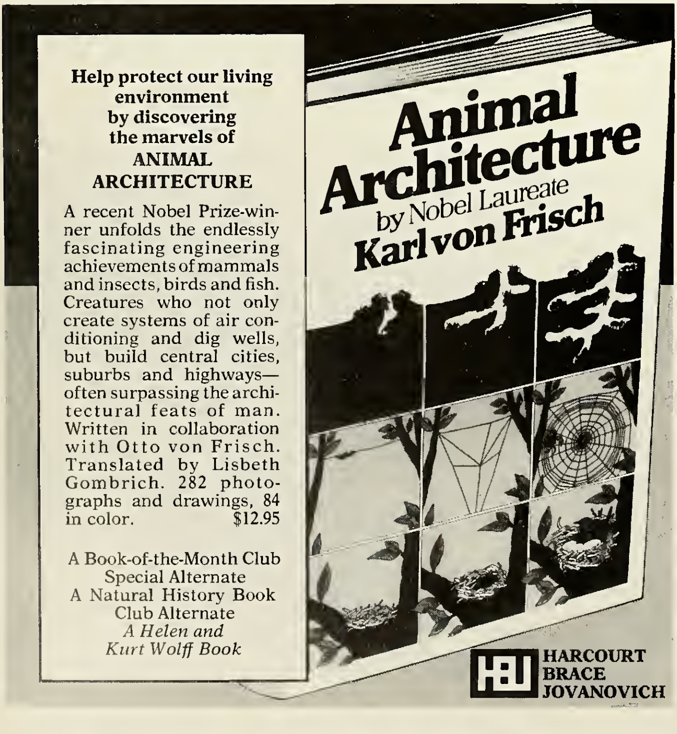
Explore with leading scholars the wonder of timeless genius!

THE UNKNOWN LEONARDO brilliantly examines Leonardo da Vinci's outstanding inventions ranging from mechanics and hydraulics to musical instruments and bronze casting; his painting, his writing, and his revolutionary ideas in fortifications and weaponry. Written by 10 renowned Vincian scholars, it draws on the fresh insights of the recently published Leonardo manuscripts, *The Madrid Codices*. Over 800 spectacular illustrations, some 300 in color. This is a unique adventure of the human spirit, a possession of beauty, and a superb work of art in its own right.



Edited by
Ladislao Reti.
$10\frac{1}{4}$" x $12\frac{3}{4}$"
$34.95 to
December 31, 1974;
$39.95 thereafter.
At bookstores

McGRAW-HILL
BOOK COMPANY



Help protect our living environment by discovering the marvels of ANIMAL ARCHITECTURE

A recent Nobel Prize-winner unfolds the endlessly fascinating engineering achievements of mammals and insects, birds and fish. Creatures who not only create systems of air conditioning and dig wells, but build central cities, suburbs and highways—often surpassing the architectural feats of man. Written in collaboration with Otto von Frisch. Translated by Lisbeth Gombrich. 282 photographs and drawings, 84 in color. $12.95

A Book-of-the-Month Club
Special Alternate
A Natural History Book
Club Alternate
A Helen and
Kurt Wolff Book

HARCOURT
BRACE
JOVANOVICH

structures with their own internal logic that is unrelated to any fundamental external cause (other than those modish will-o'-the-wisps, the "deep structures" of the human brain).

For instance, to take the best-documented case, French food has been divided into three great "domains" by Waverley Root: the domains of butter, oil, and fat (lard and goose fat). Root's theory is by now well accepted among serious gastronomes because it goes to the heart of the major taste differences among the important cooking regions of France. Everyone feels instinctively that the cooking of Provence is different from the cooking of Normandy. This intuition can be supported with innumerable examples in the form of recipes for local specialties, but the underlying difference (after we have subtracted superficial contrasts such as the entirely different fish available at Calais and Nice) is, to palate and intellect, the fat of the region. The cuisine of Provence begins and ends with olive oil (as well as tomatoes and garlic). Normandy stands for butter (along with apples and cream).

Now those combinations depend somewhat on geography, but we can look eastward along the Mediterranean littoral and find Greeks, with the same over-all ecosystem as southern France, cooking with cinnamon and mint, which are practically unknown to the Provençal menu. Saffron leaps to the fore at the Spanish border. To the north, Normans face the Belgian border and inhale the smell of the world's best fried potatoes. But they cling to Calvados and apple rings.

The point is that there is no reason other than cultural conditioning behind the preservation of these culinary cleavages, especially when you consider that in the modern era it is no economic hardship for Normans to buy olive oil or for Niçois to fry apples in butter. More to the point, there has never been any economic reason for a Marseillais not to flavor meat with mint as his kitchen cousins in Sparta like to do.

Nor is there any logic behind the gustatory fact that Koreans base their meals on a combination of soy sauce, garlic, brown sugar, and toasted sesame seeds, while Indonesians, who also favor a mixture of soy sauce and garlic, substitute molasses and peanuts to complete the equation. They just like it that way; it makes them comfortable.

Only in America have we never evolved a characteristic cultural grammar for the kitchen. We occurred too late as a nation for true regionalism to take permanent root. The few pockets of idiosyncratic cuisine that did develop (with the exception of New Orleans) have almost completely given up the ghost to the all-conquering hamburger. But this loss leaves us in a position to strike out anew, to recombine the ideas of many cultures without ethnocentric scruple. The recipe that follows is a farrago of American (scrambled eggs), French (butter, shallots, garlic), and Indian (cumin, coriander) traditions. Do not be alarmed at the quantity of butter. It is almost impossible to use too much butter with scrambled eggs. The taste improves with each added pat. Cholesterol watchers are, in any case, not invited to this particular cosmopolitan debauch.

Oeufs Brouillés Pondichéry

10 large eggs, beaten with a fork until well mixed but not foamy
8 tablespoons butter
1 tablespoon chopped shallots (or scallions)
1 clove garlic, minced
1 teaspoon ground cumin
1 teaspoon ground coriander
Salt
Pepper

1. Heat the butter in a skillet over medium-high heat until foam recedes. Add shallots (or scallions), garlic, cumin seeds, coriander, salt, and pepper. Cook, stirring until garlic begins to brown.
2. Add beaten egg all at once. Cook over very low heat, stirring, until the egg has achieved the degree of solidity you like. Stir less vigorously if you want "large-curd" scrambled eggs; stir constantly if you want "small-curd." Also, remember that the eggs will continue to cook, from the heat retained by the skillet, after they have been removed from the stove.

Yield: Four generous servings

Raymond Sokolov is a food columnist and editor of Great Recipes from The New York Times.

TRAVEL THE WORLD OF LINDBLAD

Next spring, see the Mediterranean, the Black Sea and the Baltic as they have never been seen before, on the

M/S LINDBLAD EXPLORER.

Late in March of 1975 we will sail along the West and North African Coasts from the Senegal all the way to the Nile, in what promises to be a most exciting cruising expedition. Thanks to the low draft of the Lindblad Explorer,* we will enter bays and ports where few cruise ships have ever been seen before. And we have scheduled two fascinating cruises to the Black Sea, exploring sites of immense historic and archaeological interest. All our cruises will be accompanied by famous lecturers. Our agenda for next year also includes the following expeditions: The Amazonas to Dakar, The Baltic, The Arctic Adventure, British Isles and Faroe Islands and two cruises on the Amazon. The Lindblad Explorer is operated in the famous tradition of the Swedish American Line. Please write for our cruising expeditions program for 1975.

LINDBLAD TRAVEL, INC.
Dept NHME1274
133 East 55th Street, New York, N.Y. 10022 (212) 751-2300

*Panamanian registry

Who says you can't speak another language in 60 days?

With Linguaphone, you can speak a new language – fluently and idiomatically – in as little as 60 days. It's an easy, interesting, natural method – used by leading schools and universities world-wide. You listen to and imitate flawless native speakers. No old-fashioned verb drills! Over 3,000,000 successful students. Record and cassette courses in more than 20 languages.

FREE RECORD OR CASSETTE!

Mail coupon today for free recording. It will show you how quickly and easily you can learn a new language with Linguaphone.

The secret of learning a language

Linguaphone Institute, Inc.
Dept. NHEZ1, 100 Park Avenue
New York, N.Y. 10017

I want to learn a new language in my own home. Rush my FREE record or cassette, as I've indicated, plus an illustrated folder that gives a complete explanation. I understand I will be under no obligation.

Please mark appropriate boxes:
☐ phonograph record or ☐ cassette
☐ Mr.
☐ Mrs.
☐ Ms.
Address
City
State Zip
I am most interested in ☐ French ☐ Spanish ☐ Italian ☐ German ☐ Hebrew ☐ Other

Linguaphone for Languages A Service of Westinghouse Learning Corporation

Darwin's Delay

Why did he wait twenty years to publish his theory of evolution?

Few events inspire more speculation than long and unexplained pauses in the activities of famous people. Rossini culminated a brilliant operatic career with *William Tell* and then wrote almost nothing for the next thirty-five years. Dorothy Sayers abandoned Lord Peter Wimsey at the height of his popularity and turned instead to God. Charles Darwin developed a radical theory of evolution in 1838 and published it twenty-one years later only because A. R. Wallace was about to scoop him.

Four years observing nature aboard the *Beagle* destroyed Darwin's faith in the fixity of species. In July, 1837, shortly after the voyage, he started his first notebook on transmutation. Already convinced that evolution had occurred, Darwin sought a theory to explain its mechanism. After much preliminary speculation and a few unsuccessful hypotheses, he achieved his central insight while reading an apparently unrelated work for recreation. Darwin later wrote in his autobiography:

> In October 1838 . . . I happened to read for amusement Malthus on *Population*, and being well prepared to appreciate the struggle for existence which everywhere goes on from long-continued observation of the habits of animals and plants, it at once struck me that under these circumstances favorable variations would tend to be preserved and unfavorable ones to be destroyed. The result of this would be the formation of new species.

Darwin had long appreciated the importance of artificial selection practiced by animal breeders. But until Malthus's vision of struggle and crowding catalyzed his thoughts, he had not been able to identify an agent for natural selection. If all creatures produced far more offspring than could possibly survive, then natural selection could direct evolution under the simple assumption that survivors, on the average, would be better adapted to prevailing conditions of life. Darwin then added only one additional statement, on variation, to complete his charmingly simple theory.

First, all organisms of a species vary from one another and these variations are inherited (variation); second, all species produce far more offspring than can survive (overproduction); and third, in the ensuing struggle for existence, survivors tend to preserve favorable variation (natural selection). Favorable variants accumulate gradually and continually to produce evolutionary change.

Darwin knew what he had achieved. We cannot attribute his delay to lack of appreciation for the magnitude of his accomplishment. In 1842 and again in 1844 he wrote out preliminary sketches of his theory and its implications. He also left strict instructions with his wife to publish these alone of his manuscripts if he should die before writing his major work.

Why then did he wait for more than twenty years to publish his theory? True, the pace of our lives today has accelerated so rapidly—leaving among its victims the art of conversation and the game of baseball—that we may mistakenly judge a normal period of the past as a large slice of eternity. But the span of a man's life is a constant measuring stick; twenty years is still half a normal career—a large part of life by even the most deliberate Victorian standards.

Conventional scientific biography is a remarkably misleading source of information about great men. It is a Pablum, which views scientists as simple, rational machines pursuing their insights with steadfast devotion under the drive of an internal mechanism subject to no influence but the constraints of objective data. Thus, the usual argument runs something like this: Darwin was satisfied with his theory, but theory is cheap. He was determined not to publish until he had amassed an overwhelming dossier of data in its support, and this took time. There is some truth in this argument. Darwin's great accomplishment was as much to convince the world of the *fact* of evolution as to discover its mechanism. This he achieved by the sheer weight of his careful documentation. In fact, the triumph of natural selection as a theory of evolution is a twentieth-century event. In Darwin's own lifetime, Darwinism was a minority position among evolutionists. He resides in Westminster Abbey for his documentation, not for his theory.

But Darwin's activities during the twenty years in question display the inadequacy of this traditional view. In particular, he devoted eight full years to writing four large volumes on the taxonomy and natural history of barnacles. Before this single fact, the traditionalists can only offer pap—something like: Darwin felt that he had to know what a species is before proclaiming how they change: this he could do only by working out for himself the classification of a difficult group of organisms—but not for eight years, and not while be sat on the most revolutionary notion in the history of biology. Darwin's own assessment of this work stands in his autobiography.

by Stephen Jay Gould

> Besides discovering several new and remarkable forms, I made out the homologies of the various parts . . . and I proved the existence in certain genera of minute males complemental to and parasitic on the hermaphrodites. . . . Nevertheless, I doubt whether the work was worth the consumption of so much time.

So complex a question has no simple answer, of course, but I think we may be sure of one thing: the negative effect of fear must have played at least as great a role as the positive need for additional documentation. Of what, then, was Darwin afraid?

When Darwin achieved his Malthusian insight, he was twenty-nine years old. He held no professional position, but he had acquired the admiration of his colleagues for his astute work aboard the *Beagle*. He was not about to compromise a promising career by promulgating a heresy that he could not prove.

What was his heresy? The belief in evolution itself is the obvious answer. Yet I am convinced that this cannot be a major part of the solution; for, contrary to popular belief, evolution was a very common heresy during the first half of the nineteenth century. It was widely and openly discussed, opposed, to be sure, by a large majority, but admitted or at least considered by many of the great naturalists.

A few months ago a remarkable pair of Darwin's early notebooks were published with extensive commentary by Howard E. Gruber and Paul H. Barrett (*Darwin on Man: A Psychological Study of Scientific Creativity*, E.P. Dutton & Co., New York). These so-called M and N notebooks were written in 1838 and 1839, while Darwin was compiling the transmutation notebooks that formed the basis for his sketches of 1842 and 1844. They contain his thoughts on philosophy, esthetics, psychology, and anthropology. On rereading them in 1856, Darwin described the notebooks as "full of metaphysics on morals." They include many statements showing that he believed in and feared to expose something he perceived as far more heretical than evolution itself: philosophical materialism—the postulate that matter is the stuff of all existence and that all mental and spiritual phenonena are its by-products. In short, at its most irreverent, materialism contends that mind is a product of brain.

The notebooks are clear on two additional points: First, Darwin was interested in philosophy and aware of its implications. He knew that the primary feature distinguishing his theory from all other evolutionary doctrines was its uncompromising philosophical materialism. Other evolutionists spoke of vital forces, directed history, organic striving, and the essential irreducibility of mind—a panoply of concepts that traditional Christianity could accept in compromise, for they permitted a Christian God to work by evolution instead of creation. Darwin spoke only of random variation and natural selection.

Second, Darwin resolutely applied his materialistic theory of evolution to all phenomena of life, including what he termed "the citadel itself"—man's mind. And if mind has no real existence beyond the brain, can God be anything more than an illusion invented by an illusion? In one of his transmutation notebooks, he wrote:

> Love of the deity effect of organization, oh you materialist! . . . Why is thought being a secretion of brain, more wonderful than gravity a property of matter? It is our arrogance, our admiration of ourselves.

This belief was so heretical that Darwin even sidestepped it in *The Origin of Species* (1859), where he ventured only the cryptic comment that "light will be thrown" upon man and his origin. He gave vent to his beliefs, only when he could hide them no longer, in the *Descent of Man* (1871) and *The Expression of the Emotions in Man and Animals* (1872). A. R. Wallace, the codiscoverer of natural selection, could never bring himself to apply it to man's mind, which he viewed as the single divine contribution to the history of life. Yet Darwin cut through 2,000 years of philosophy and religion in the most remarkable epigram of the M notebook:

> Plato says in Phaedo that our "imaginary ideas" arise from the preexistence of the soul, are not derivable from experience—read monkeys for preexistence.

In his commentary on the M and N notebooks, Gruber labels materialism as "at that time more outrageous than evolution." He documents the persecution of materialistic beliefs during the late eighteenth and early nineteenth century and concludes:

> In virtually every branch of knowledge, repressive methods were used: lectures were proscribed, publication was hampered, professorships were denied, fierce invective and ridicule appeared in the press. Scholars and scientists learned the lesson and responded to the pressures on them. The ones with unpopular ideas sometimes recanted,

published anonymously, presented their ideas in weakened forms, or delayed publication for many years.

Darwin had experienced a direct example as an undergraduate at the University of Edinburgh in 1827. His friend W.A. Browne read a paper with a materialistic perspective on life and mind before the Plinian Society. After much debate, all references to Browne's paper, including the record (from the previous meeting) of his intention to deliver it, were removed from the minutes. Darwin learned his lesson, for he wrote in the M notebook:

> To avoid stating how far, I believe, in Materialism, say only that emotions, instincts, degrees of talent, which are hereditary are so because brain of child resembles parent stock.

The most ardent materialists of the nineteenth century, Marx and Engels, were quick to recognize what Darwin had accomplished and to exploit its radical content. In 1869, Marx wrote to Engels about Darwin's *Origin:*

> Although it is developed in the crude English style, this is the book which contains the basis in natural history for our view.

Marx later offered to dedicate volume 2 of *Das Kapital* to Darwin, but Darwin gently declined, stating that he did not want to imply approval of a work he had not read. (I have seen Darwin's copy of volume 1 in his library at Down House. It is inscribed by Marx who calls himself a "sincere admirer" of Darwin. Its pages are uncut. Darwin was no devotee of the German language.)

Darwin was, indeed, a gentle revolutionary. Not only did he delay his work for so long, but he also assiduously avoided any public statement about the philosophical implications of his theory. In 1880, he wrote to Karl Marx:

> It seems to me (rightly or wrongly) that direct arguments against Christianity and Theism hardly have any effect on the public; and that freedom of thought will best be promoted by that gradual enlightening of human understanding which follows the progress of science. I have therefore always avoided writing about religion and have confined myself to science.

Yet the content of his work was so disruptive to traditional Western thought that we have yet to encompass it all. (G.G. Simpson marked the centennial of Darwin's *Origin* in 1959 with an essay entitled *One Hundred Years Without Darwin Are Enough.*) A reluctance to accept Darwin's materialism and an attempt once again to invest living matter with some special property form the basis of many humanists' doubts about Darwinian theory (see Arthur Koestler's *The Ghost in the Machine* or *The Case of the Midwife Toad*). This, I confess, I do not understand. Wonder and knowledge are both to be cherished. Shall we appreciate any less the beauty of nature because its harmony is unplanned? And shall the potential of mind cease to inspire our awe and fear because several billion neurons reside in our skulls?

Columnist Stephen Jay Gould teaches geology at Harvard University.

"A great, sad, wonderful book—through poetry, through the evocation of all that specialists know about these huge, intelligent sea mammals now being hunted to extinction."—Loren Eiseley

MIND IN THE WATERS

A Book to Celebrate the Consciousness of Whales and Dolphins

Assembled by Joan McIntyre

Royalties from the sale of this book will go to Project Jonah to be used in its campaign for a world moratorium on the commercial killing of whales and dolphins.

Beautifully blending text and photographs, this "whole-earth catalog" of the Cetacea family brings together the writings of scientists, anthropologists, naturalists and just plain whale buffs, along with whale lore from throughout history to explore the likelihood that these creatures—now being destroyed at an incredible rate—possess a full intelligence, that they are aware and can think.

Mind in the Waters tells all that is known about whales and dolphins, but it will haunt readers for what it suggests—not only about another species, but about themselves.

"This year's strongest ecological attack on idiocy and greed . . . This extraordinary collection goes beyond any studies yet published and will appeal to a reader's imagination, intuition and heart, and should satisfy the scientific mind as well."

—*The Kirkus Reviews*

A SCRIBNER/SIERRA CLUB BOOK
70 black and white pictures, 16 pages of color. 8¼ x 11. $14.95

NH

At your bookstore or order directly from:
CHARLES SCRIBNER'S SONS, Dept. MN
597 Fifth Avenue, New York, N.Y. 10017

Please send me ______ copy(ies) of Mind in the Waters @ $14.95. I enclose check or money order which includes appropriate sales tax.

Name ______

Address ______

City ______

State ______ Zip ______

Additional Reading

CAPTIVE BREEDING (Page 6)

The Whooping Crane. F. McNulty. E. P. Dutton & Company, Inc., New York, 1966.

Sandy. D. O. Hyde. The Dial Press, New York, 1968.

The Whooping Crane. R. P. Allen. National Audubon Society, New York, 1952.

THE SHELL GAME (Page 22)

The Life of the Seashore. W. H. Amos. McGraw-Hill Book Company, New York, 1966.

Observations on the Social Behaviour of the Land Hermit Crab. B. A. Hazlett. *Ecology*, Early Spring, 1966.

Animals Without Backbones. R. Buchsbaum. University of Chicago Press, Chicago, 1972.

Shell Selection Behaviour of Hermit Crabs. E. S. Reese. *Animal Behaviour*, October, 1962.

THE TAUNG SKULL (Page 38)

The Ascent of Man. D. Pilbeam. Macmillan, Inc., New York, 1972.

The Missing Link. M. A. Edey. Time-Life Books, New York, 1973.

Human Evolution. B. Campbell. Aldine Atherton, Inc., Chicago, 1966.

Adventures with the Missing Link. R. A. Dart. Institutes Press, Philadelphia, 1967.

A HOMINID SKULL (Page 44)

The Emergence of Man. J. E. Pfeiffer. Harper and Row, Publishers, New York, 1970.

Early Man. F. C. Howell. Time-Life Books, New York, 1968.

Guide to Fossil Man. M. H. Day. World Publishing Company, New York, 1968.

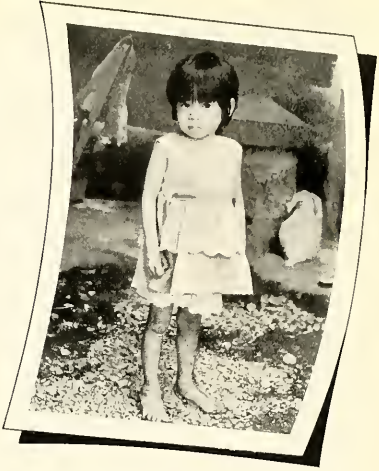
LIGHT TO STEER BY (Page 46)

The Wasps. H. E. Evans and M. J. Eberhard. University of Michigan Press, Ann Arbor, 1970.

Bees: Their Vision, Chemical Senses, and Language. K. Von Frisch. Cornell University Press, Ithaca, 1971.

Light and Vision. M. Rudolph and C. G. Mueller. Time-Life Books, New York, 1972.

Wasps. J. P. Spradbery. University of Washington Press, Seattle, 1973.



Cristina found a friend

One who is helping her survive

Cristina Aguilar's case is typical.

Her father works long hours as a sharecropper despite a chronic pulmonary condition that saps his strength. Her mother takes in washing whenever she can. Until recently, the total income of this family of six was about $13.00 a month. Small wonder that they were forced to subsist on a diet of unpolished rice, swamp cabbage, and tiny fish the children seine from a nearby river.

Now Cristina enjoys the support of a Foster Parent in Tennessee whose contribution of sixteen dollars a month assures Cristina and her entire family of better food and health care. And, when Cristina is old enough, the help of her Foster Parent will give her a chance for an education, an opportunity to realize whatever potential she has to offer to this world.

How can such a small monthly contribution do so much in the life of Cristina's family? In the underdeveloped countries where Foster Parents Plan is at work, the need is so great, the poverty so deep, that very few dollars can make a tremendous difference. In fact, with PLAN programs and services in place, the very communities where Foster Children live are aided toward self-improvement.

To become a Foster Parent is a special responsibility . . . and a most rewarding one. You become an influence in shaping the life of your Foster Child. You come to know the child through photos and a regular exchange of letters. Progress reports show you vividly how much good your contribution is doing. Of the many fine causes that ask for your support, few can offer you such a tangible and immediate way to help others.

Today, more than ever, people like you are needed to join in this wonderful work. Hundreds of children wait in desperate, often shocking, circumstances for a Foster Parent to offer them a hand toward a decent life.

Please join us if you can . . . or let us send you more details about how PLAN is working around the world.

FOSTER PARENTS PLAN, Inc.
Box 403, Warwick, Rhode Island 02886

YES, I would like to know more about becoming a Foster Parent.
Please send me the full facts ☐.
I am ready now to become a Foster Parent to a boy ☐ girl ☐ age ____
country ____________ or whoever you feel needs me most ☐.
Please send a photo and case history of the Foster Child. Enclosed is my first contribution ☐ $16 monthly, ☐ $48 quarterly, ☐ $192 annually.
I can't become a Foster Parent now. I enclose a gift of $______.

NAME ____________
ADDRESS ____________ DATE ____________
CITY ____________ STATE ____________ ZIP ____________

In Canada, write 153 St. Clair Ave. West, Toronto, Ontario MV4 1P8

PLAN operates in Bolivia, Brazil, Colombia, Ecuador, Peru, Indonesia, Korea, Haiti, Viet Nam, and the Philippines. PLAN is registered with the U.S. State Department Advisory Committee on Voluntary Foreign Aid. All contributions are tax deductible. Foster Parents Plan, Inc. is a non-political, non-profit, non-sectarian, independent relief organization.

HN-X-0004

"The whole book's an adventure, that of a superb naturalist in the making."*

Ivan T. Sanderson's

Green Silence

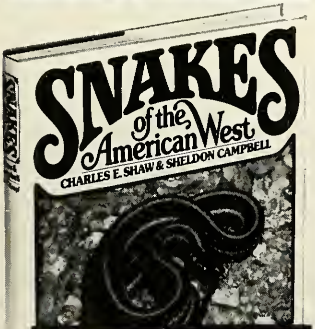
THE STORY OF THE MAKING OF A NATURALIST

Edited and with an introduction by Sabina Sanderson. Illustrated with drawings by the author.

"It records Sanderson's first youthful encounter with the tropical rain forests that were to be the great love of his professional life."
—**Publishers Weekly*

$9.95 at bookstores or send check to David McKay Company, Inc., 750 Third Avenue, New York, N.Y. 10017

McKAY



All in color!

74 brilliant full-color photographs illustrate the most magnificent and comprehensive book ever published about the snakes of America's seven western states. Every single species described in fascinating detail: habits, habitats, characteristics, reproduction, diet, hearing, sight, etc. Published in conjunction with the San Diego Zoo. SNAKES OF THE AMERICAN WEST by Charles E. Shaw & Sheldon Campbell. A main selection of the National Science Book Club. 331 pages, $8^1/_2$ x $9^1/_2$. $12.50 at bookstores. Knopf

Molecules between the Stars

The discovery of chemical compounds in interstellar space has led to the new field of astrochemistry and a rethinking of how stars are born

Chemistry dominates existence on earth—it affects the weather, the flow of energy, and most important for us, it is essential to all life processes. But until about thirty years ago, astrochemistry, or the chemistry of regions beyond the solar system, was a largely neglected field of research. The main reason is that astronomy was then primarily dependent on optical instruments, and the objects in the universe under study were those giving off optical radiation. These are the visible stars and nebulae—the gas and dust clouds between the stars—which are typically so hot that chemical compounds cannot survive in them. Molecules there are torn apart into their atomic fragments as soon as they are formed. The spectra of most stars and nebulae accordingly show lines characteristic of free atoms but no indication of molecules.

There were, however, two notable exceptions. Optical spectra of cool red stars did show complex absorption bands indicating the presence of a few simple molecules such as carbon monoxide (CO) and titanium monoxide (TiO) in their atmospheres. And the spectra of certain other stars showed features resulting from absorption by such molecular fragments, or free radicals, as methylidyne (CH), ionized methylidyne (CH^+), cyanogen (CN), and hydroxyl (OH). Analysis showed that these molecular fragments were not in the atmosphere of the stars but rather in the cool, diffuse clouds of interstellar gas that lie between the stars and the earth. Until 1963 these were the only interstellar molecules known, and few astronomers paid much attention to them.

Among the triumphs of astrophysics in the past few decades has been the discovery that stars burn by nuclear fusion in their cores with the resultant understanding of the details of the structure and evolution of these objects. We currently have a good idea of how long a star will last before it finally burns out and dies. Chemistry plays only a minor, almost negligible role in most of the lifetime of a star except at its birth—the condensation of a star from an interstellar gas cloud—when it clearly plays a crucial role. The observation thirty years ago of optical absorption lines due to the few simple molecules in interstellar clouds already mentioned was the first piece in a complicated jigsaw puzzle of interstellar chemistry. Thanks to radio astronomers, many more pieces have been turning up in recent years at an accelerating rate. At the time of this writing, some twenty-six different molecules have been identified in interstellar space. There is good reason to hope that when all the evidence is sorted and put together, it will complete our understanding of the full life cycle of the stars.

To comprehend the relation between chemistry and star birth, we must begin with a description of the relationship between the stars and the interstellar gas that makes up about 10 percent of the mass of our galaxy. This gas, like the matter in stars, is composed mostly of hydrogen and helium with small traces of most other elements. When stars approach the end of their normal lifetimes, they first become red giants, like Betelgeuse in the constellation Orion. These aging stars have huge atmospheres that are cool and dense enough to enable tiny grains of graphite, silicates, and other chemical compounds to form. The pressure of the radiation comby Richard McCray

ing from a star's interior blows these grains out of the star's atmosphere into interstellar space, and the grains drag along a good deal of the star's gaseous atmosphere. This process is probably one of the mechanisms whereby vast regions of interstellar space are filled with cosmic dust and explains the dark areas seen in the Milky Way, especially in the constellations Sagittarius and Scorpius toward the center of the Galaxy. When stars finally die, they often do so with violent supernova explosions, which return most of their remaining gaseous material to interstellar space.

At the same time that some stars are dying, new stars are being born from the interstellar gas. The propensity of the gas to condense through the force of its own gravity causes it to fragment into interstellar clouds. These clouds collapse and fragment still further until the little fragments become hot and dense enough to begin burning as stars. Thus, the interstellar gas is a reservoir to which stars return much of their material at death and from which new stars are born in the Galaxy. An example of this process is found in the Great Nebula in the sword of Orion—a dense gas cloud illuminated by some very bright young stars. With infrared telescopes scientists can observe deep within the dark dust cloud behind the Orion Nebula from which visible light cannot escape. There one finds a number of luminous infrared sources that are probably newly forming protostars. Perhaps in another few million years enough young stars will form in this cloud to illuminate and heat a region of gas much larger than the present nebula. The resultant, spectacular display of hot fluorescent gas would

TRAVEL THE WORLD OF LINDBLAD

Journeys into hidden worlds with

LINDBLAD IN SOUTH AMERICA

Lars-Eric Lindblad invites you on journeys to the great continent of South America. Here you may visit some of the most scenic areas in the world. Ethnically and culturally they are also very exciting. For it was here that the proud and peace-loving civilization of the Incas spread their empire from shore to shore. And on Easter Island a pre-historic people erected huge stone statues that even today puzzle anthropologists. Seek out and witness the achievements of these amazing cultures. Perhaps you want to explore the headwaters of the mighty Amazon or visit Tierra del Fuego on an incredible Nature Tour. All of these expeditions are fully described in our "Lindblad in South America" brochure. Write for it today or see your travel agent.

LINDBLAD TRAVEL, INC.
Dept. NHSA1274
133 East 55th Street, New York, N.Y. 10022
(212) 751-2300

POPULAR ARCHAEOLOGY

Popular Archaeology is a magazine that brings you the Mystery and Excitement of the Search and Excavation. The archaeology that is covered in each issue is on a world-wide basis with special emphasis on the prehistory and history of the United States.

Order from:

P.O. Box 4211
Arlington, Virginia 22204

Name____________________
Please Print

Address____________________

City, State, Zip ____________________

☐ Payment of $9.50 is enclosed for one year.
☐ Payment of $18.00 is enclosed for two years.
☐ Payment of $25.00 is enclosed for three years.

Appreciating the Natural World...

The Observer's Pocket Series

Use these handy manuals for quick reference in the field and to increase your general knowledge. Give them as small but meaningful gifts, and cause someone you know to make new discoveries about the world around them.

Recognized for nearly 40 years, The Observer's are British in origin and worldwide in application*. Their low price, beautifully reproduced illustrations—many in color! — factual accuracy, convenient size, and hard covers distinguish them as worthwhile additions to nature study bookshelves.

ASTRONOMY
BIRDS*
BIRDS' EGGS*
BUTTERFLIES*
CACTI
CATS
COMMON INSECTS*
DOGS
FERNS*
FLOWERING TREES & SHRUBS
FRESHWATER FISHES*
GARDEN FLOWERS
GEOLOGY
GRASSES, SEDGES & RUSHES*
HORSES & PONIES
HOUSE PLANTS
LARGER MOTHS*
MANNED SPACEFLIGHT
POND LIFE*
SEA FISHES*
SEASHORE
TREES & SHRUBS*
UNMANNED SPACEFLIGHT
WILD ANIMALS*
WILD FLOWERS*
WEATHER
ZOO ANIMALS

*Primarily British in orientation.

$2.50 each

from your bookseller

or

FW

Frederick Warne & CO., INC.
101 Fifth Avenue
New York, New York 10003

bear witness to the formation of a new star cluster. The remaining gas would be so hot it would again dissipate and spread over a vast region of interstellar space. This action may currently be taking place near the young hot stars of the Pleiades cluster, which are bathed in a faint nebulosity that is probably the remnant of the gas cloud from which the cluster was formed.

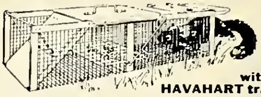
Although we understand in general terms that gravity is responsible for the collapse of interstellar gas clouds and the formation of stars within them, the details of the star formation process remain obscure. The situation is analogous to the problem of rain—we know that all rain comes from clouds, but not all clouds produce rain. All stars come from interstellar gas clouds, but not all interstellar clouds produce stars. What are the necessary conditions for the condensation of stars, and what determines the masses of the resulting new stars?

Fortunately, astronomy is no longer limited to relatively short, visible wavelengths. Optically opaque interstellar clouds, within whose depths stars are born, become transparent to infrared telescopes at the longer infrared wavelengths. As has been mentioned, astronomers have observed infrared sources inside the Orion dust cloud and believe these to be protostars. But infrared astronomy is still in its infancy. So far it has provided some information on the temperature and luminosity of protostars, but little of the high-precision spectroscopic information that has yielded so much data about the structure and composition of optically visible stars.

Interstellar dust clouds are also transparent to radio waves, and in the past decade the technology of radio astronomy has developed to the level where high-precision radio spectroscopy is possible. A brilliant series of observations has resulted in the discovery that cool interstellar clouds are filled with molecules.

Unlike an atom, a molecule can tumble end-over-end: its component atoms can also vibrate with respect to each other in internal motions. When a molecule changes its internal motion, radiation is emitted or absorbed at a precise and characteristic frequency. Typically, these frequencies fall in the radio wave or

Catch 'em ALIVE 'n UNHURT



with a HAVAHART trap!

Official HAVAHART trap captures invading squirrels, rabbits, coons, cats, mice, rats, skunks, animal nuisances of all kinds. Metal top and doors protect creature from weather, make trap rigid, preserve it from animal damage. Can be set with one or both doors open. Fully assembled. No jaws or springs to break. Extremely durable, many in use 20 years. Send 25c (credited to first order) for exclusive guide to good trapping and price list.

HAVAHART, 158 Water St., Ossining, N. Y. 10562
Please send new guide and price list.

Name______________________________

Address________________________Zip________

actual size

oneness

A subtle linking of man's religious symbols, delicately wedded together by the artisan.

With illustrated descriptive booklet

14K with 24" chain $37.50
Sterling Silver $16.75

ISAAC SOLTES DESIGN NH
1923 S. McPherrin Ave.
Monterey Park, Calif. 91754
Check or Money Order / Money-back Guarantee

A naturalist's adventure, in the heart of Europe:

The Swiss Safari

AUGUST 23 TO SEPTEMBER 6, 1975

The first and last nights of this innovative tour are at deluxe hotels; for the main part of the safari we stay at inns that never advertise, a mountain refuge and farmhouse; we visit Roman excavations and baroque churches, see cheese being made, meet local people and savour local dishes and wines.

A highlight of the safari is the sunrise hike through the totally unspoiled Swiss National Park, teeming with wildlife.

Detailed brochure available from:

HANNS EBENSTEN TRAVEL, INC
55 WEST 42 STREET, NEW YORK, NY 10036
TELEPHONE (212) 354-6634

WEEKENDS IN THE
WILDERNESS

Adirondack, High Peaks, Catskills.
Instruction in mountaineering, survival, backpacking
On foot, snowshoes, skis, in canoes.
Also 9 to 13 day Concentrated Courses.
Write for Fall, Winter, Spring schedule H.
North American Wilderness Survival School
205 Lorraine Avenue, Upper Montclair,
N.J. 07043. Tel: (201) 783-7711

NATURE ON STAMPS

The BIRDS & the BEES & the ANIMAL KINGDOM on GENUINE POSTAGE STAMPS.

SAMPLES & APPROVALS – $1
Satisfaction Guaranteed

Mil Med Stamps
P.O. BOX 297-NH AURORA, CO. 80010

infrared range. This circumstance gives each molecule a characteristic radio fingerprint by which astronomers can deduce molecular abundances deep inside an interstellar cloud, just as optical spectra are used to deduce the atomic composition of hot stars and nebulae.

A radio telescope used to identify the composition of interstellar clouds is like a cosmic nose that sniffs around where stars are born. What such a cosmic nose would smell would be the noxious vapors of such compounds as carbon monoxide (CO), hydrogen cyanide (HCN), methyl, or wood, alcohol (CH_3OH), ammonia (NH_3), ether (CH_3OCH_3), and various other molecules, all nicely preserved in formaldehyde (H_2CO). In addition to the twenty-six molecules that have already been seen and identified, a half-dozen or so radio spectral lines have been observed but have not yet been identified with known molecules.

The abundance of interstellar molecules was a great surprise to most astronomers. The environment of interstellar space is a hostile one for molecules. Ultraviolet light from stars destroys most molecules in a decade or so, much less time than that required for new molecules to form. Molecules can survive only in the cool opaque interstellar clouds where dust grains are dense enough to shield them from the high-frequency radiation of starlight.

Besides providing a sheltered environment for molecules, interstellar dust plays a vital role as a catalyst for molecule formation. Chemical reactions proceed extremely slowly at the densities and temperatures of interstellar clouds. By analyzing the radio spectrum lines from molecules, astronomers have determined that these clouds have low gas densities on the order of one million molecules per cubic centimeter, about equal to that in the best laboratory vacuum ever achieved on earth, and temperatures ranging from about −268°C. (5° above absolute zero) to −180°C. The time required under those conditions for two hydrogen atoms, for example, to collide with each other and stick to form a molecule of H_2, the ordinary hydrogen gas found on earth, is far greater than the estimated age of the universe. One hydrogen atom flying around in interstellar space might collide with

AN ORDINARY DOG IN AMERICA EATS BETTER THAN SHE DOES.

Cristina eats whatever she can find in the garbage. And that is far less than some prowling dog would find in your garbage can.

For just $12 a month, you can save such a child.

Through our Children, Inc. "Adoption" program you can help provide a child with a better diet, new clothes and medical attention. Even an education.

But there's not a moment to lose. Every 60 seconds, five or six more children will die from starvation.

Write direct to Mrs. Jeanne Clarke Wood, Children, Incorporated, Box 5381, Dept. NH12D, Richmond, Va. 23220.

I wish to "adopt" a boy ☐ girl ☐ in________________.
Name of Country

I will pay $12 a month ($144 a year). Enclosed is my gift for ☐ a full year ☐ the first month. Please send me the child's name, story, address and picture.

I understand that I can correspond with my child, and continue the "adoption" longer than one year if I wish. Also, I may discontinue the "adoption" at any time.

☐ I cannot "adopt" a child, but want to help $________.
☐ Or, I will pledge $________ per month.
☐ Please send me further information.
☐ If for a group, please specify________________.
Church, Class, Club, School, Business, etc.

Name________________________
Address________________________
City__________State__________Zip________

You can "adopt" a child from any of the following countries: Bolivia, Chile, Colombia, Guatemala, Honduras, Hong Kong, India, Iran, Japan, Korea, Lebanon, Mexico, Nigeria, Paraguay, Peru, Syria, Thailand, U.S.A.—Appalachian children or American Indians. (Or a child of greatest need.) All gifts are fully tax deductible.

CHILDREN, INCORPORATED

Discover Galapagos

For the discriminating traveler who wishes to visit the unique Galapagos Islands at leisure, the only way is on our two-week cruises aboard the motor yachts Cathchar and Laura Maria, with a naturalist guide.

Discover Belize

The British-owned 12-passenger schooner Golden Cachalot with its dedicated crew has moved to the little-known waters of the Gulf of Honduras, and operates two-week voyages of discovery, touching at landing places in Belize, Guatemala and Honduras, with visits to the barrier reefs and cays and forays inland; for naturalists, archaeologists and others of enquiring minds.

Both these cruises operate all year round and departures are scheduled until the end of 1975.

Brochures on both programs are available from.

HANNS EBENSTEN TRAVEL, INC
55 WEST 42 STREET, NEW YORK, NY 10036
TELEPHONE (212) 354 6634

SHELLS
FOSSILS
MINERALS
INDIAN
ARTIFACTS

Send 50¢ for Illustrated Catalog

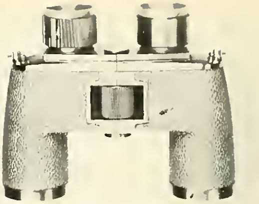
DOVER SCIENTIFIC
Box 6011C Long Island City, N.Y. 11106

KOMURA/BROOKS 2 x TELE EXTENDER
MULTICOATED 4 ELEMENT
DOUBLE FOCAL LENGTH AT A FRACTION OF CAMERA LENS PRICE
FOR HASSELBLAD
BRONICA
MAMIYA RB 67
PENTAX 6 x 7
BURLEIGH BROOKS OPTICS, INC., • 44 BURLEWS CT., HACKENSACK, N.J. • 201-489-1300

out of print, scarce, rare NATURAL HISTORY BOOKS
The Book Chest
Botany, Zoology,
Orchidology,
Ornithology, Entomology,
Ichthyology,
Herpetology, etc.
CATALOGUE 7 AVAILABLE
19 Oxford Place/Rockville Centre, New York 11570

another in a few weeks, but they would hardly ever stick together. For an H_2 molecule to form, the pair of atoms must emit radiation during the moment of collision. At the temperatures of interstellar gas clouds, atoms do not emit radiation when they collide with one another—they simply bounce off each other. Thus the chance for this radiative association reaction to take place is infinitesimal. What is nearly impossible for atoms in flight, however, may not be so unlikely on a bed of graphite. Hydrogen atoms in the gas clouds are constantly running into the surfaces of the dust grains where they can stick until they find a mate and become molecules.

Once molecules have been formed, they can swap partners in a chemical exchange reaction. For example, the ubiquitous hydroxyl radical (OH) might be formed when an oxygen atom trades places with one of the hydrogen atoms in the H_2 molecule in the reaction $O + H_2 \rightarrow OH + H$. Such reactions in the gas might build up a rich variety of molecules in the cloud even if only H_2 molecules are formed on cosmic dust grain surfaces. This kind of activity, however, is strongly inhibited by the chilly interstellar environment. For atoms and molecules to change partners, the chemical bond of the original pair must first loosen, and that requires some heat. The interstellar clouds are far too frigid for much chemical exchange to take place between ordinary molecules (that is, the molecules we are familiar with on earth) or even the highly reactive radicals. But not all atoms and molecules in interstellar space are ordinary. Along with gas and dust, interstellar space contains cosmic rays, electrically charged bare nuclei of atoms that streak through the gas at almost the speed of light and strip electrons off atoms and molecules. The legacy of the cosmic rays is a small fraction of ions and ion molecules—atoms and molecules that lack one or more pieces from their neutralizing shroud of electrons and thus have a net positive charge of electricity. The electrical influence of an ion is so strong that even at the lowest temperatures it can easily disrupt the bonding of a molecule and initiate chemical reactions. In contrast to neutral atoms and molecules, the ions are con-



BUSHNELL 7x35 CUSTOM
Mfg. List $149.50 Postpaid $89.50

This is an example of the deep discount prices on high quality optics that is found in our FREE catalog. This catalog lists and illustrates an outstanding selection of camera lens, telephoto lens, telescopes, binoculars etc., plus valuable information on how to properly select them. Write for it today.

GIL HEBARD OPTICS
COURTHOUSE SQ., KNOXVILLE, ILL. 61448

DROLL YANKEES HUMMINGBIRD FEEDER has 3 feeding stations, a three year guarantee, and is simple, strong & easy to clean. $8.25 postpaid. Write for free catalog of our bird feeders & bird song phonorecords.

DROLL YANKEES® INC., Box 98-N
Foster, Rhode Island 02825
Telephone orders: 401/647-2727

CRUISE INLAND FLORIDA

Relax 5 days on the Lazy Bones plus airboat and swamp buggy jaunts in Everglades country. $187 complete. Mid-Dec. thru April. Featured on Jack Douglas TV series. For brochure and reservations write:

Capt. Stan Maurer SHANTY BOAT CRUISES
Box 366D, Fort Myers, Florida 33902

ATTENTION ANIMAL LOVERS

Ted and Pat Derby will conduct a 6 week course in their techniques of the care and handling of wild animals. Interested persons, call (805) 688-3634, or write P.O. Box 1786, Buellton, CA. 93427.

BOOK HUNTING?

Virtually any book located—no matter how old or long out-of-print. Fiction, nonfiction. All authors, subjects. Name the book—we'll find it! (Title alone is sufficient.) Inquire, please. Write: Dept. 65.

BOOKS-ON-FILE
UNION CITY, NEW JERSEY 07087

stantly swapping and stealing atoms to build complicated molecules in an environment of simpler ones.

Radio and infrared observations indicate that stars form in the same dense regions of the sky in which most interstellar molecules are found. The molecules are therefore thought to play a vital role in initiating the star formation process. Gravity gives interstellar clouds a propensity to collapse, but that does not assure the formation of stars. There are many effects that resist gravity. Ordinary thermal pressure, for example, tends to make the gas clouds expand. Without some mechanism to radiate away their heat energy, interstellar clouds would reach an equilibrium between gravitational attraction and thermal pressure, and no stars would form. That mechanism may be interstellar molecules.

When molecules collide with each other, the internal motions of which they are capable are excited. Thus, unlike interstellar atoms, colliding molecules can emit radiation and are therefore able to rid interstellar clouds of their heat energy. The radio emission lines astronomers have observed, those from carbon monoxide molecules, for example, may be the very radiation by which a gas cloud gets rid of its heat energy and begins to fragment into a cluster of stars.

Although the study of interstellar chemistry is still in its infancy, it has already indicated that molecules probably play a vital role in initiating the gravitational collapse that leads to the birth of a star. It also seems likely that the chemistry of charged ions plays an important role in the formation of molecules. These ions are made by cosmic rays in interstellar space. The rays probably come from supernova explosions that occur in our galaxy every century or so when a massive star runs out of fuel and collapses. In this parting shot, a dying star sprays the interstellar medium with radiation, thereby insuring that the Milky Way remains a fertile place, where star birth can continue for eons to come.

Richard McCray is an associate professor of physics and astrophysics and a fellow of the Joint Institute for Laboratory Astrophysics of the University of Colorado and the National Bureau of Standards at Boulder, Colorado.

TRAVEL THE WORLD OF LINDBLAD

A totally fascinating new world dawns when you travel with

LINDBLAD IN AFRICA

Because we believe we spend more time and effort researching our African safaris than anyone else, we can offer the most rewarding journeys to this fabulous continent. Africa is a nature paradise and probably the most photogenic part of the world. It is teeming with an unbelievable variety of wildlife. And Lars-Eric Lindblad offers a wide selection of African tours. We operate our famed Wing Safari (why spend your vacation on dusty roads), The Lindblad Safari, The Botswana Wing Safari, and the Ethiopian Nature Safari. You may want to visit historic Ethiopia and Yemen, the lovely Seychelles in the Indian Ocean, take our West Africa Safari or embark on our newly scheduled Round Africa Expedition. We travel only in small groups and our safaris, unlike most others, are all-inclusive. Write today for our comprehensive "Lindblad in Africa" brochure, or see your travel agent.

LINDBLAD TRAVEL, INC.
Dept. NHAF 1274
133 East 55th Street, New York, N.Y. 10022
(212) 751-2300

Our hidden heritage

Despite fourteen centuries of Christianity, pagan myths are still part of the calendar and the imagination of the English-speaking world. Now Brian Branston, in this handsomely illustrated book, draws on the extensive archaeological evidence, pagan *Charms*, folklore and early writings to bring our forebears' dieties to life.
"Learned and agreeable."
—Sir Thomas Kendrick

THE LOST GODS OF ENGLAND
Second Edition

Brian Branston

With 124 illustrations, $10.00

OXFORD UNIVERSITY PRESS
200 Madison Avenue, New York, N.Y. 10016

LIVE IN THE WORLD OF TOMORROW . . . TODAY!

And our FREE 164 PAGE CATALOG is packed with exciting and unusual values in ecological and physical science items — plus 4,500 finds for fun, study or profit . . . for every member of the family.

A BETTER LIFE STARTS HERE

ACTUAL WORKING SOLAR HOME PLANS

Learn all about the most fascinating possible home of the future. It can be your "now" answer to today's energy crisis in housing. Expert Dr. Harry E. Thomason tells advantages, problems, savings, and more in this important 20-pg fact-filled booklet. Also includes 8-page oversize insert of basic, actual solar home plans, a valuable guideline to you and your architect in fitting space requirements, design ideas, and local area building codes.

No. 9440E....(Solar House Plans)....................$10.00 Ppd.

● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ●

PRO ELECTRONIC SOUND CATCHER

Parabolic mike w/18¾" reflecting shield & 2 I.C.'s in amplifier magnifies signals 100X that of omni-directional mikes. Catch a songbird ½ mile off; QB's huddle strategy; sounds never before heard. Super directivity gives highest signal to noise ratio poss. Safe: auto. cuts off ear damaging noises. Earphones, tape recorder output, tripod socket. Req. two 9v trans. batt. (not incl).

No. 1649E....(5½LB.)....................$299.00 Ppd.
BIG EAR "TOY" MODEL #80,176E....................$32.25 Ppd.

● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ●

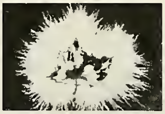
MYSTERY OF ENERGY AND AGING

Science fact or farce? Can our Great Pyramid unlock the mysteries of energy & aging — show that the ancient Egyptians contradicted nature? Did someone really get 85 shaves from a blade kept in a pyramid? Test claims like meat not rotting, things not rusting! Users of exact scale models of Cheop's pyramid oriented to true North claim all sorts of strange phenomena based on resonating energy. Ours is already assembled, ⅛" see-thru acrylic, 6 x 9¼ x 9¼".

Stock No. 71,817E....................$20.00 Ppd.

● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ●

NEW! KIRLIAN PHOTOGRAPHY KIT!



Experiment in the fascinating new field of "Kirlian electrophotography—images obtained on film without camera or lens by direct recording of electric charge transmitted by animate & inanimate objects." Each "aura" differs—animate aura said to change corresponding to physical changes. Kit incls portable darkroom, double transformer isolated from power source; instrs.

Stock No. 71,938E....................$49.95 Ppd.
"HIGH VOLTAGE PHOTOGRAPHY" by H. S. Dakin
No. 9129E....(60-PG. PPBK BK.)....................$5.00 Ppd.
DELUXE KIRLIAN PHOTOGRAPHY SET
Stock No. 72,053E....................$399.00 Pod.

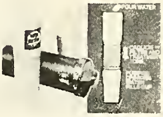
GREAT INT'L. PAPER PLANE BOOK!

Official fly-them-yourself book of paper airplanes from *SCIENTIFIC AMERICAN'S* "1st International Competition". Includes plans of all winning entries, time-aloft records, photos, technical data, commentaries. Has 20 unusual designs on perforated pages for easy tear-out. You won't believe how some of them fly! Amusing, entertaining 128 pages, 9"x11¾".

Stock No. 9391E....................$2.95 Ppd.

● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ●

DO DRINK THE WATER, ANYWHERE!



Enjoy safe, *delicious* water from your home tap or wherever in the world you are! Compact 9x3" dia. purifier removes harmful poisonous, bad tasting foreign substances, kills bacteria that ord. charcoal filters don't. Pour water in top, make a qt. of pure water in a min., up to 1500 gal. for less than 3¢ a gal.—enuf to last avg. family of 4 ab. 2 yrs. Camp, travel with it!

No. 71,867E....(INCLS TRAVEL CASE)....................$39.95 Ppd.
LOW COST FAUCET-TYPE WATER FILTER
No. 61,034E....(ATTACH TO TAP)....................$7.95 Ppd.

● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ●

ERECT A "PRO" WEATHER STATION

Match your forecasting skill with *anyone!* Set up permanent meterology sta. for reliable readings: windspeed, precipitation, barometric pressure, temp., humidity; get wind-chill, cloud types. Top qual. equipt.: rooftop remote reading pneumatic windspeed ind.; 11" rain guage; holosteric barometer (inches, etc.); hi-lo self register thermometer; wet-dry bulb hygrometer More!

No. 80,216E....(w/372 PG. LOG)....................$69.50 Ppd.
BEGINNER'S KIT: COMPL., LOW COST
Stock No. 71,022E....................$18.95 Ppd.

● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ●

AUTHENTIC SCALED WINDMILLS

Real-thing replicas show wind direction, wheel silently revolves on ball bearings. Give your grounds unique rural charm! Great centerpiece for planter, flowers. Use to hold yard light, house number, sign or as mailbox. For school, a fine "energy crisis" science project — does everything but pump water. Heavy gauge steel, durable outdoor finish; aluminum color w/red trim.

No. 71,923E....(17" DESK MODEL)....................$10.95 Ppd.
4½ FOOT—14 LB.....No. 71,924E....................$32.50 Ppd.
8 FOOT—46 LB.....No. 85,229E....................$44.95 FOB

● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ●

3" ASTRONOMICAL REFLECTING TELESCOPE

See stars, moon, planets close-up! 30 to 90X. Famous Mt. Palomar Type. Aluminized & overcoated 3" diameter f/10 primary mirror, ventilated cell. Fork type equatorial mount. Durable PVC tube. Includes 1" F.L. 30X Ramsden, Barlow lens to triple power, 3X finder telescope, hardwood tripod. FREE: "STAR CHART", "HOW TO USE" book.

Stock No. 85,240E....................$ 49.95 Ppd.
DELUXE 3" REFLECTOR TELESCOPE....#80,162E....................$ 79.95 Ppd.
4¼" REFLECTOR (45X to 135X)....#85,105E....................$149.50 FOB
6" REFLECTOR (48X to 360X)....#85,187E....................$249.50 FOB

MAIL COUPON FOR GIANT FREE CATALOG!

164 PAGES • MORE THAN **4500 UNUSUAL BARGAINS**

Completely new Catalog. Packed with huge selection of telescopes, microscopes, binoculars, magnets, magnifiers, prisms, photo components, ecology and Unique Lighting items, parts, kits, accessories — many hard-to-get surplus bargains. 100's of charts, illustrations. For hobbyists, experimenters, schools, industry.

EDMUND SCIENTIFIC CO.
300 Edscorp Building, Barrington, N. J. 08007
Please rush Free Giant Catalog "E"

Name ______________________________
Address ______________________________
City ______________ State ________ Zip ________

☐ PLEASE SEND GIANT FREE CATALOG "E"

30 DAY MONEY-BACK GUARANTEE
YOU MUST BE SATISFIED OR RETURN ANY PURCHASE IN 30 DAYS FOR FULL REFUND

COMPLETE & MAIL WITH CHECK OR M.O.

EDMUND SCIENTIFIC CO. 300 Edscorp Building, Barrington, N.J. 08007

How Many	Stock No.	Description	Price Each	Total

Add Handling Chg.: $1.00, Orders Under $5.00, 50¢, Orders Over $5.00 ________
TOTAL $ ________

I enclose ☐ check ☐ money order for $ ________

NAME ______________________________
ADDRESS ______________________________
CITY ______________ STATE ________ ZIP ________

"POP" YOUR OWN BUTTONS

Make customized badges in minutes! Create your own, reproduce photos with name affixed. Great anywhere, from kindergarten to business meetings, to school sports. Sell for profit! Ingenious badge machine makes permanent buttons; kit includes precision cast hand die press, matching color dies, starter asst. for 25 complete badges including plastic protectors. Sold nationally for several dollars each, yours will pay off fast. Step-by-step instrs.

Stock No. 71,974E........$31.50 Ppd.

● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ●

LIE DETECTOR TYPE METER

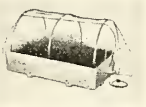
DOES SHE LOVE ME?
HATE ME?
TELLING THE TRUTH
YOUR AGE, REALLY?

Amazing Emotion Meter reveals hidden likes, dislikes. Easy to use; sensitive, accurate. Measures changes in body resistance caused by changes in emotional state. Needle movement indicates emotional response (not whether favorable or unfavorable). Effectiveness depends on questions asked and interpretation. Unique 10-oz. set ideal for entertainment and education — parties, science projects, psychological experiments. Requires 9V transistor battery (not included). Instructions.

No. 42,194E....(2⅞ x 4 x 1¾")........$19.95 Ppd.

● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ●

STARTS SEEDS IN 3 TO 5 DAYS!



New thermostatically controlled electric greenhouse provides constant 70° growing temperature, accelerates seed germination, helps produce healthy thriving plants ready for outdoor planting. Big 3 sq. ft. planting area—29" x 15" x 4" box holds ½ bushel of growing medium. Germinates tomato seeds in 3-5 days; asters, dahlias, petunias, wk. or less. Incl. 3" x 4" ft. clear plastic cover, supports. Uses reg. home current.

Stock No. 80,153E........$16.95 Ppd.

● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ●

TAKE TEMPERATURES IN *SECONDS*

Edmund's new *electronic* oral thermometer obsoletes glass mercury type. *Seconds* instead of minutes, more *accurate*, much *easier* to read! Put disposable cover (supply incl.) on flexible probe, place under tongue, push button, dial meter center, read temp fast in F.° & C.°. 92-106°F. (33-41°C.) in ¼° increments, 97-101°F. to 1/10°. Safe, hygienic, no squinting. Compact metal case fits in doctors', nurses' shirt pocket. Incls 9v trans batt., instrs.

Stock No. 42,210E........$25.00 Ppd.

● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ●

BIG 6 x 6" OPAQUE PROJECTOR!

Great buy! New lightweight compact enlarges any picture or print matter (up to 6 x 6") for big projection 30 to 144" away. True color reproduction! Feat.: optically polished *glass* lenses, heat-resist. plate glass mirror, curl-free slide tray, heavy duty motor, large fan. Just put two 200w household bulbs (not incl) inside its steel body, plug in 8' cord, place copy in slide tray. You can't beat it under $100! 13 x 13½ x 7¾"

Stock No. 80,217E....(9 LB.)........$79.95 Ppd.

DELUXE 5 x 5" OPAQUE PROJECTOR

No. 71,272E....(SUPER SHARP)........$129.00 Ppd.

● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ●

50-150-300 POWER MICROSCOPE

Amazing Value—3 Achromatic Objective Lenses on Revolving Turret! Color-corrected, cemented achromatic lenses in objectives give far superior results to single lenses usually found in this microscope price range. Results are worth the difference! Fine rack and pinion focusing. Imported!

Stock No. 70,008E........$45.00 Ppd.

MOUNTED 500 POWER OBJECTIVE:

Threaded achromatic lenses, 3mm F.L.

Stock No. 30,197E........$7.75 Ppd.

LIVE IN THE WORLD OF TOMORROW . . . TODAY!

And our FREE 164 PAGE CATALOG is packed with exciting and unusual values in ecological and physical science items — plus 4,500 finds for fun, study or profit . . . for every member of the family.

A BETTER LIFE STARTS HERE

NEW BINOCULAR-TO-CAMERA HOLDER

Fits any camera for exciting telephoto pictures. 35-mm camera with 7 x 50 binocular brings distant object 7 times nearer. Ideal for long-range photos of wild life, ships, people, planes, etc. Attaches easily. Use any binocular or monocular—and camera—still or movie, color or black & white. Gray crinkle and bright chrome finish. 10" long. Full directions.

Stock No. 70,223E........$17.95 Ppd.

● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ●

QUALITY DETECTOR UNDER $40

New Edmund developed, fully transistorized BFO unit capable of locating quarter at 18"—powerful 6 trans. oscillator-amplifier circuit. Easily compares to others priced 50% higher! Aluminum pole and housing—not plastic! 6" waterproof search coil (Faraday shielded to elim outside interference); long 50 hr battery (9V) life; powerful 2" speaker; 1-knob on-off tune control. Perfect balance; lightweight (2 lb). Great buy!

Stock No. 80,222E........$39.95 Ppd.

● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ●

AMAZING NEW WANKEL ENGINE KIT!

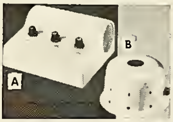
Build your own see-through motorized model of revolutionary pistonless type engine, rights for which GM recently paid $50 million and may be a '75 Vega option. Only one considered modifiable to meet new standards. Replaces piston, cylinder, crank assemblies with rotating discs (sections removed for firing chambers). Smaller than conventional; fewer parts, greater reliability, same speed w/less horsepower. Switch. Reg. 2—1.5V batt. (not inc.).

No. 71,424E....(4½" x 5" x 9")........$7.95 Ppd.

519 Pg "Wankel" BOOK—#9439E........$15.25 Ppd.

● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ●

CAN'T SLEEP, RELAX? TRY THIS!



Electronic sound conditioner simulates 4 kinds of soothing sounds of ocean surf and rain. "White sound" helps mask unwanted noise, adds restful, intriguing background sound. Program the solid-state unit to your own need: 2 surf, 2 rain; or "white sound", proven by medical tests to have analgesic effects. Great for meditation, restlessness, sleeplessness psychology.

(A) No. 71,997E....(7½ x 7 x 3½") 110V AC........$79.95 Ppd.

(B) AS ABOVE, BUT "WHITE SOUND" ONLY

No. 71,980E....(6" Rd. x 3½" Hi)........$28.00 Ppd.

● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ●

"FISH" WITH A MAGNET

Go treasure hunting on the bottom! Fascinating fun & sometimes profitable! Tie a line to our powerful new specially designed 150 lb. pull Magnet—drop it overboard in bay, river, lake or ocean. Troll it along bottom—your "treasured" haul can be outboard motors, anchors, other metal valuables. Has 6 stacked ceramic magnets. Lifts more than 150 lbs. under water!

No. 71,135E....(3¼ x 3⅞")........$17.50 Ppd.

75-LB. PULL (1 LB.) W/3 CERAMIC MAGNETS

No. 71,150E....(1 11/16 x 3¼")........$11.00 Ppd.

USE COUPON ON OTHER PAGE TO ORDER & GET GIANT FREE CATALOG

EDMUND SCIENTIFIC CO.
TELEPHONE: 609-547-3488
300 EDSCORP BLDG.
BARRINGTON, NEW JERSEY 08007
ORDER BY STOCK NUMBER · SEND CHECK OR MONEY ORDER
MONEY-BACK GUARANTEE

Announcements

Puppets: Dance and Drama of the Orient will be on display through April 20, in Gallery 77 of The American Museum of Natural History. This special exhibit features hand, rod, and string puppets; masks, scenery, and musical instruments; and films of puppet performances. Scenes from classical Asian dramas will be presented Wednesdays and Sundays from 1:00 to 4:00 P.M. On Thursday, December 12, at 2:00 P.M. Karen Bennett will give a talk in Gallery 77 on shadow puppets.

On Sunday, December 15, International House will present the **Volga Ensemble,** a program of traditional Russian and Eastern European songs, dances, and music. This performance is scheduled for 2:00 P.M. in the Auditorium.

Insects and Us opens December 3 in the African Corridor on the second floor. The exhibit will examine the interactions between humans and insects, including eating habits, food sources, and communication of diseases.

Human Variation, a new exhibit in the Hall of the Biology of Man, investigates the complexities of human diversity. Through films, photographs, cartoons, and simple diagrams, the exhibit depicts the myriad genetic and environmental influences that affect human populations.

At the Hayden Planetarium, **A Midnight Clear,** running through January 6, looks at the winter skies and the Star of Christmas of 2,000 years ago. Showings at the Planetarium are at 2:00 and 3:30 P.M. during the week, with more frequent showings on weekends. Admission is $1.75 for adults, $1.00 for children.

The following **Films** will be shown in the Museum Auditorium. There is no charge for museum visitors and showings start at 2:00 P.M. On December 4 and 7, visitors can see *The Bakhtiari Migration,* the hazardous seasonal movement of a half million nomads in Iran. *Miss Goodall and the Wild Dogs of Africa* portrays the rejection of an outcast African wild dog, Solo, December 11 and 14. *Remnants of Race,* about the Bushmen of the Kalahari Desert, will be shown with *African Heritage* on December 18. On December 21, *Desert People* features the aborigines of Australia.

The Museum's 25-foot-high holiday **Christmas Tree** in the Roosevelt Memorial Hall is decked with glistening origami figures of such creatures as whales and fleas, dinosaurs and butterflies.

A colorful and tasteful item, ideal for gift giving, is the 1975 **Natural History Calendar—A Photographic Portfolio of Southwest Indians** (retail edition). Send $2.00 to Box 5123, Des Moines, Iowa 50306.

THE GIFTS OF MOTHER EARTH
FROM THE
COLLECTOR'S CABINET
DEPT. NH, [illegible] MADISON AVENUE, NEW YORK, N.Y. 10021

VISIT OUR TREASURE HOUSE OF NATURAL HISTORY OR SEND 50¢ FOR OUR FULL-COLOR "MOTHER EARTH CATALOG"

Branches: Chadds Ford, Pa., [illegible], Fla., Miami Beach, Fla., Portland, Ore., Springfield, Va., Syracuse, N.Y., Washington, D.C.

Also at [illegible], Davison's, Foley's, [illegible], Strawbridge & Clothier, Woodward & Lothrop and 50 other fine dept. stores nationwide. Write for the store nearest you.

op row BUTTERFLY METAL SHADOW BOX with bright orange Malaysian Appias Nero and brilliant iridescent blue Brazilian Morpho Aega. 6¼" x 8¼". *$12.50.* BUTTERFLY LAQUE with blue and black Brazilian Morpho Achilles, 7½". *$10.00.* Center row JUMBO OSTRICH EGG from South Africa. 5" to 6". With Lucite stand. *$15.00.* VILDFLOWER FRAME with Orange Cosmos from Utah, 5⅛" x 7¼". *$8.50.* THE FABLED CHAMBERED NAUTILUS from the Philippines. 6" to 8". *$5.00.* (Add *$3.00* for ucite "planter" easel as illustrated.) PEARLED NAUTILUS from the Philippines. 6" to 8". *$7.50.* (Add *$3.00* for Lucite stand, as illustrated.) COLORFUL SEA URCHIN rom the English Channel. Orange or purple. 4" to 4½". *$7.50.* (Add *$2.00* for Lucite holder.) **Bottom row** MAN-EATING PIRANHA from the Brazilian Amazon. About 6". *15.00.* WHITE CLUSTER CORAL from the Philippines. 5" to 7". *$5.00.* SHEAFFER PEN on BRAZILIAN AGATE BASE. 4" to 6". *$15.00.* FOSSIL FERNS, 280 to 310 MILLION YEARS OLD! From the coal beds of Pennsylvania. Plaque about 4" to 5". *$5.00.* Plaque about 7" to 8". *$10.00.* (Add *$2.50* for Lucite easel.) PICTURE MARBLE from aiwan. Miniature mountains with natural scenes. Height about 6". *$15.00.*

SMIRNOFF SILVER®
Pierre Smirnoff
VODKA

THE SILVER MARTINI.
FOR PEOPLE WHO WANT A SILVER LINING WITHOUT THE CLOUD.

SMIRNOFF SILVER. NINETY POINT FOUR PROOF. SMIRNOFF LEAVES YOU BREATHLESS®

SMIRNOFF SILVER® VODKA. 90.4 PROOF. DISTILLED FROM GRAIN. STE. PIERRE SMIRNOFF FLS. (DIV. OF HEUBLEIN, INC.) HARTFORD, CONN.

The abstraction inside your mind can become real on film with a camera that doesn't hold you back.

You're comfortable with a Minolta SR-T from the moment you pick it up. This is the 35mm reflex camera that lets you concentrate on the picture, because the viewfinder shows all the information needed for correct exposure and focusing. You never have to look away from the finder to adjust a Minolta SR-T, so you're ready to catch the one photograph that could never be taken again.

The SR-T 101 lets you use microprism focusing with a ground glass collar. A scale in the viewfinder shows your shutter speed, from 1 to 1/1000th second, plus bulb.

Minolta SR-T 100/Minolta SR-T 101/Minolta SR-T 102

The SR-T 102 gives you split screen focusing with a microprism collar, and adds an aperture read-out to the shutter scale in the finder. And the SR-T 102 makes it easy to get deliberate multiple exposures with remarkable accuracy.

All Minolta SR-T cameras give you the patented "CLC" through-the-lens metering system. It protects you from under-exposure by automatically compensating in high contrast light. Meter-coupled Minolta lenses stay at maximum aperture, so the finder is always at full brightness until the moment of exposure.

When you see something that needs a different perspective, snap on one of the complete system of interchangeable Minolta lenses. It takes just seconds, with no ASA or f/stop realignment to waste your time.

Nurture your imagination with a responsive Minolta SR-T. For more information, see your photo dealer or write Minolta Corporation, 101 Williams Drive, Ramsey, N.J. 07446. In Canada: Anglophoto Ltd., P.Q.

Minolta helps you nurture beauty.

Is your camera a means of self-expression? If so, enter the Minolta Creative Photography Contest. Grand Prize: two weeks in the south Pacific islands for two, $1000 cash, and a Minolta SR-T 102. 1428 other valuable prizes will be awarded. Nothing to buy. Minolta equipment not required. See your Minolta dealer for details and registration. Or write: Minolta Creative Photography Contest, Box 1831, Blair, Neb. 68009.